• JULY 1952 •

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Could You Use SAVINGS Like These?

40% less
Fuel Consumption
50% more
Boiler Capacity

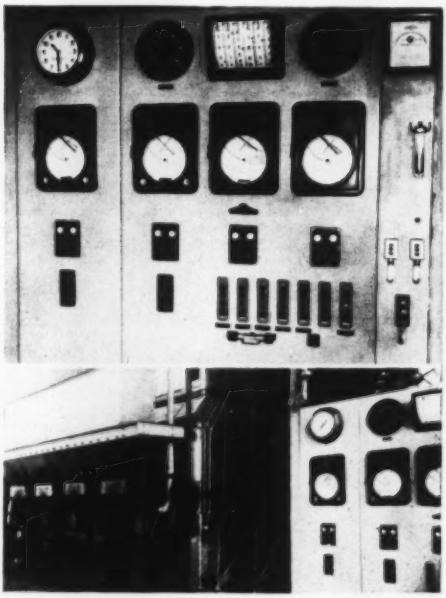
Bailey Meters and Controls Insure Savings at Kerr Bleaching & Finishing Works, Concord, N. C.

The key to complete returns on any investment in new power equipment is a fully co-ordinated system of meters and controls. It's the old story, the tail that wags the dog—careful attention to this comparatively minor part of the over-all installation cost can mean the difference between profit and loss in operation.

Here's where Kerr Bleaching & Finishing Works has cut operating costs—by installing *co-ordinated* Bailey Meters and Controls. The installation includes Bailey Meter Combustion Control. and Bailey Two-element Feed Water Control.

Such a co-ordinated system is an important plus for Bailey customers. Nowhere else can you buy such a complete range of equipment, selected without bias to do the best job for you. Nowhere else can you find such expert engineering service, immediately available through conveniently located direct sales and service representation. May we help you?

Call our local branch office or write for Bulletin 15-H. A-113



Control panel, showing completely co-ordinated Bailey Meters and Controls at Kerr Bleaching and Finishing Works, Concord, N. C.

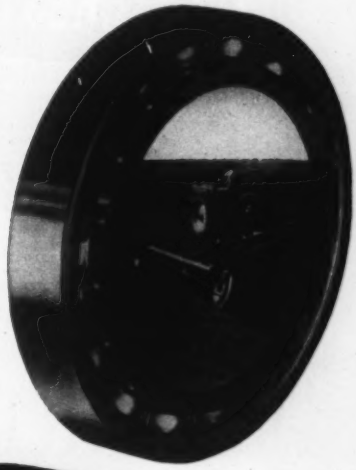
BAILEY METER COMPANY

1026 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

No conversion problem ...

in these dual-purpose plants



Jig borers and jets, trucks and tanks, household appliances and electronic instruments, all use New Departure ball bearings of the same materials, same heat treatment, the same methods of precision manufacture.

Thus conversion from one to the other in New Departure's three great plants is largely a matter of changing the emphasis on types and sizes.

The capacity of the world's largest ball bearing plants is your assurance of the best possible production schedules.

New Departure's engineers and vast resources for research are freely at your disposal.

Nothing Rolls Like a Ball...

North Side Bristol group are "guns-and-butter" plants.

NEW DEPARTURE
BALL BEARINGS

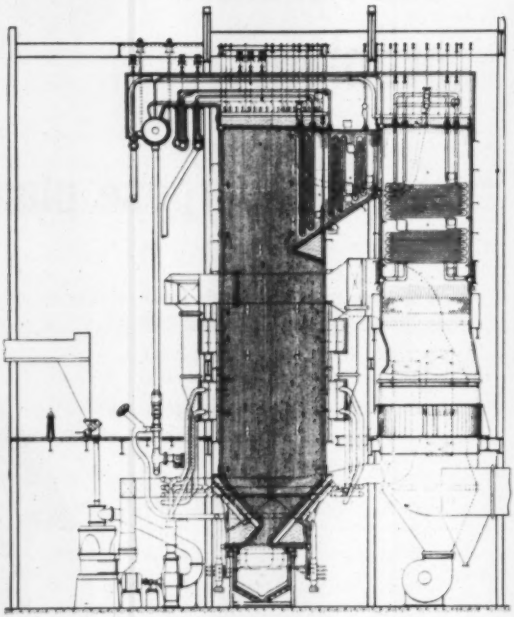
NEW DEPARTURE • DIVISION OF GENERAL MOTORS CORPORATION • BRISTOL, CONNECTICUT 186

MECHANICAL ENGINEERING, July, 1952, Vol. 74, No. 7. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations

CHESTERFIELD STATION

Virginia Electric & Power Company

C-E controlled circulation boilers



The C-E Unit shown above is now being installed in the Chesterfield Power Station of the Virginia Electric & Power Company at Wheelright, near Richmond, Virginia. Stone & Webster Engineering Corporation are the engineers and constructors.

It is designed to serve a 100,000 kw turbine-generator operating at a throttle pressure of 1450 psi with a primary steam temperature of 1000 F, reheated to 1000 F.

The unit is of the controlled-circulation, radiant type with a reheater section located between the primary and secondary superheater surfaces. An economizer section is located below the rear superheater section and regenerative type air heaters follow the economizer surface.

Pulverized coal firing is employed, using bowl mills and tilting, tangential burners. Arrangements are made to use oil as an alternate fuel.

B-575

C-E

COMBUSTION ENGINEERING—SUPERHEATER, INC.

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ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

Link-Belt Research and Engineering . . . Working for Industry

Making farming easier . . . more profitable

Since 1875, LINK-BELT has worked hand-in-hand with America's farm machinery manufacturers to step up farm production.

LINK-BELT met a basic farm machinery need with its first product—a detachable-link chain that could be serviced in the field. Today Link-Belt supplies many products that serve as basic components for practically every farm machine you can name.

Link-Belt screw conveyors handle grain, straw and various materials in combines, balers, spreaders and other implements. Link-Belt precision bearings provide free-rolling support for shafts of all descriptions. And from the complete Link-Belt line of chains and sprockets, manufacturers select the specific chain best-suited for their particular drive or conveying need.

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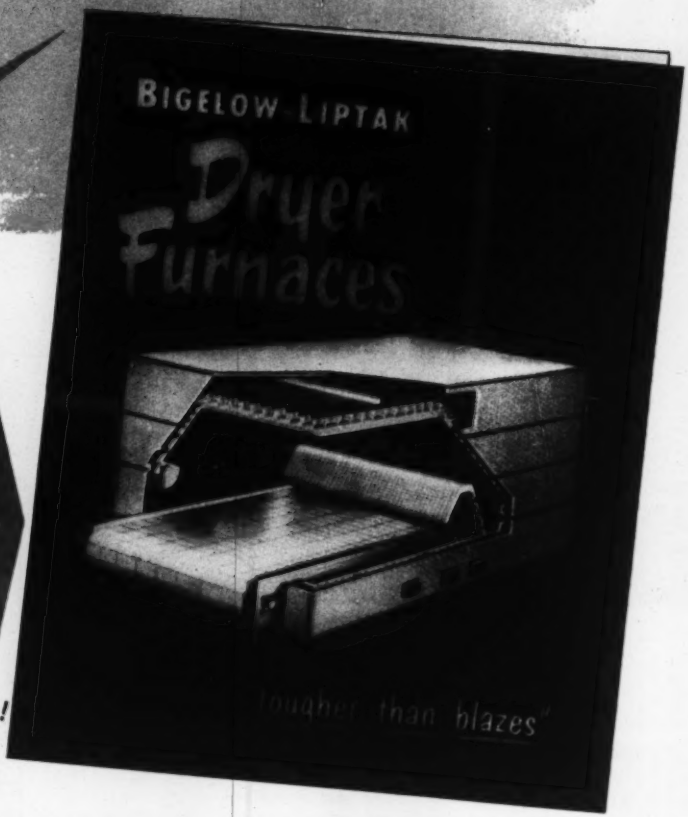

THIS NEW BULLETIN ON BL DRYER FURNACES

No obligation, of course!

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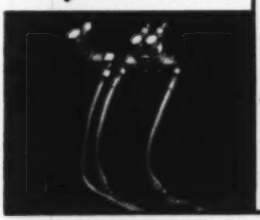
CHIKSAN

Chance Vought Cutlass, on Aircraft Carrier flight deck with folded wings.

Chiksan hydraulic aircraft swivel joints are made for pressures ranging from 1000 psi to 3000 psi.

Chiksan swivel joints shown below as installed in folding wing mechanism of Chance Vought Corsair.



In the Air... on the Production Line

In World War II when Chance Vought created the folding wing Corsair to serve our Navy as a carrier based fighter plane, Chiksan Aircraft Swivel Joints provided the "muscle" and flexibility to fold and unfold the wings.

Today Chance Vought is turning out a deadlier jet offspring of the Corsair — the Cutlass — to join the battle. Again Chiksan Aircraft Swivel Joints have been called in to give sinew and stamina to the newest folding wings — saving precious space on Carrier — speeding the Cutlass on its missions of defense.

From blueprint, through forge and lathe, to torturing laboratory test and punishing field operation, Chiksan Ball-Bearing Swivel Joints surpass the most exacting tests of Industry and Armed Services — operate unceasingly through excessively high pressures and extremes of temperature — prove with every twist and turn that Chiksan Speeds the Flow of Enterprise.

The Flow of Enterprise Relies on

CHIKSAN

Ball-Bearing Swivel Joints

If any operation or installation of yours, existing or projected, calls for more flexibility, greater stamina, longer life and added economy, Chiksan's Research and Development Division will help your engineering department find the answer.

Representatives in Principal Cities. Write today for Catalog 2A "Aircraft Swivel Joints" Dept. "-ME

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Weil Equipment Mfg. Corp. (Division), Houston 1, Texas • Chiksan Export Company (Subsidiary), Brea, California • Newark 2, N. J.

You've never seen a meter bearing as trouble-free!

...has lowest torque under pressures to 5000 p.s.i.
..."Life-Lubricated" at the factory

This exclusive stainless steel Pressure-Seal Bearing is virtually frictionless, free from maintenance and leaks. O-Ring seals of a resilient, chemically inert material are retained in a unique mounting which assures minimum torque even under high static pressure. No metal-to-metal contact. No adjustments . . . no periodic lubricating. Bearing shaft provides direct mechanical connection between float and pen . . . no lost motion . . . higher sustained accuracy. Shafts are interchangeable . . . can be replaced if damaged.

Be sure to check all the advantages that contribute to the greater accuracy of the new Foxboro Flow Meters. Write for Bulletin 460. **The Foxboro Company, 1827 Neponset Avenue, Foxboro, Massachusetts.**

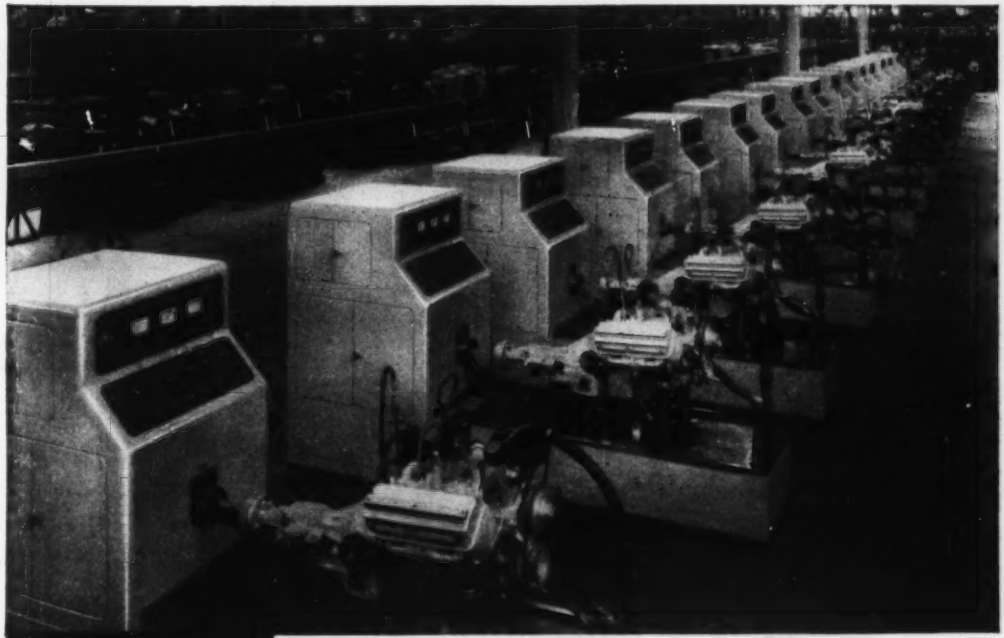
Available in round (shown here) and rectangular cases.

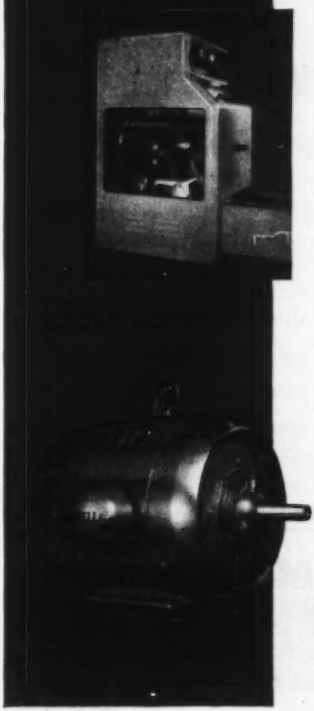
OTHER NEW BASIC ADVANCES

- **Precision Float Assembly** with stainless steel ball chain and collet-type clamp insures slip-proof, friction-free transmission of float motion to the recording pen.
- **Sure-Seal Check Floats** insure perfect seating; submerged in mercury to prevent frosting and fouling.
- **Union-coupled U-bend** eliminates gaskets; always lines up.
- **Calibrated Damping Plug** fully adjustable under pressure.

FOXBORO REG. U.S. PAT. OFF. ... First in FLOW METERS

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND





New test stand proves performance before engine meets chassis!

In these Nankervis Hot Engine Test Stands, installed in one of the country's newest automotive engine plants, 40-H.P. Howell Motors act as the test load for new engines. It's an unusual application for electric motors, but Howell Motors handle the job easily.

Here, inefficient engine operation from poor carburetion, timing, ignition, etc., is detected immediately when horsepower does not reach prescribed standards. Faulty parts can be quickly replaced or adjustments made while the engine is still on the stand.

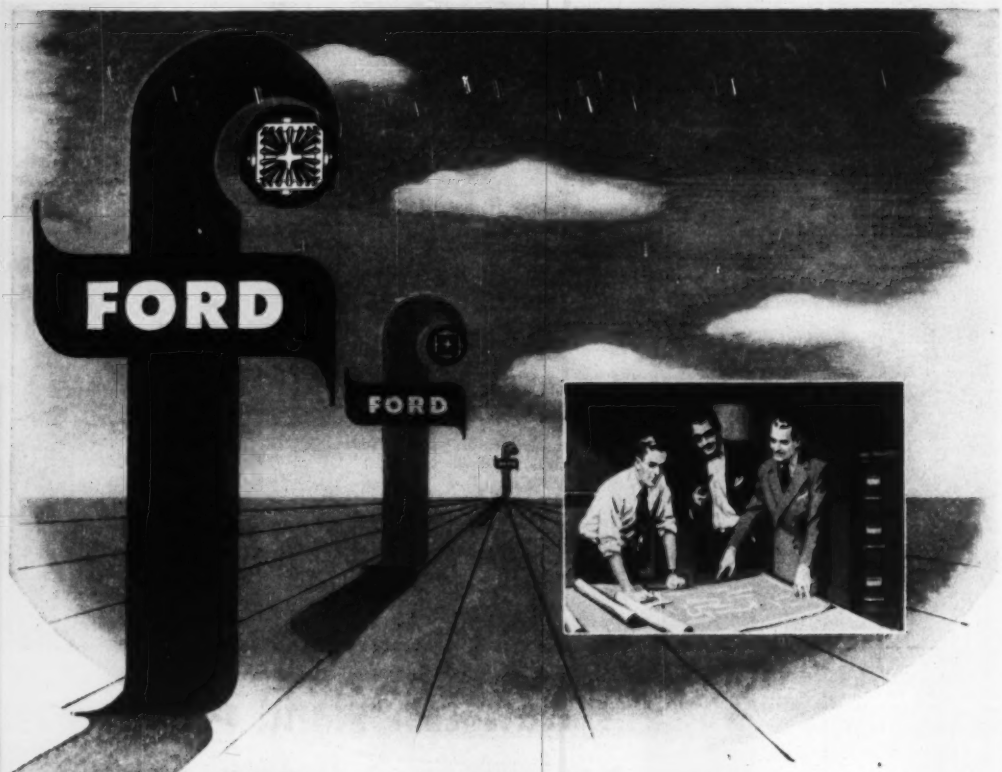
Testing procedures like this one make special demands on the electric motors. Highest accuracy is a must. Howell Motors' superior design, quality materials and precision construction assure the performance necessary for exacting operations.

You, too, can benefit by using Howell engineering services and precision-built Howell Motors from 1/6 to 250 H.P. in standard NEMA frame sizes. Howell Motors do your tough jobs better, and at the same time give you economy through long life and trouble-free operation. It will pay you to contact the Howell representative in your city or write to us today.

HOWELL Red Band MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Precision-built industrial motors since 1915



PROBLEMS OF TOMORROW
are our business today!

Tomorrows and tomorrows—five . . . ten . . . twenty years from now—are being shaped at Ford today. For the Ford Instrument Company continues to pioneer the future as it has for the past thirty-seven years.

Recognized as a leader in the field of intricate computing devices and other nationally important automatic equipments, Ford has *pioneered* in the research, development, design and manufacture of mechanical, hydraulic, electro-mechanical, and electronic instruments and components for specialized military and industrial applications.

Today, Ford Instrument Company is devoting its design talents to solving vital and highly classified problems whose solution will help make better and safer tomorrows for all.

If you are a qualified engineer—either experienced on automatic equipment design or a recent graduate—and are interested in your Tomorrows, consider Ford today. Write for information.

FORD INSTRUMENT COMPANY
DIVISION OF THE SPERRY CORPORATION
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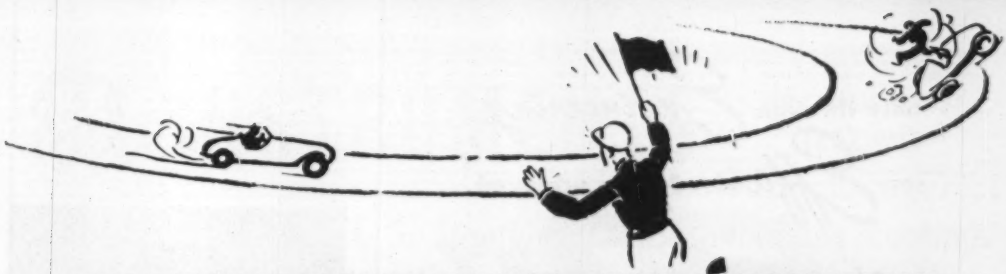
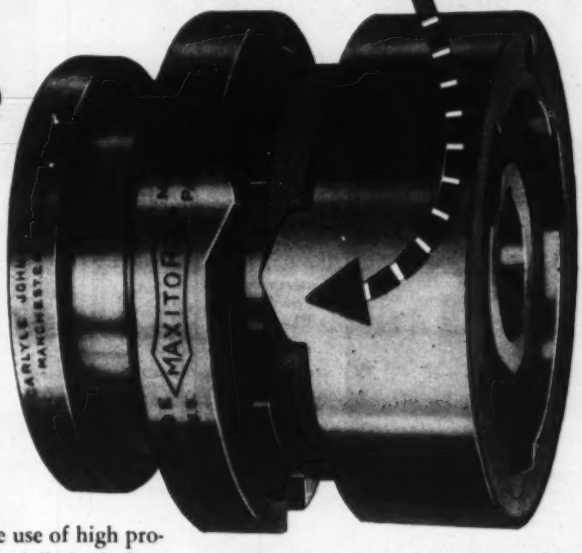


INDUSTRIAL SPEEDWAYS, TOO, NEED PROTECTION

MAXITORQ
automatic
OVERLOAD RELEASE CLUTCH



The tremendous expansion in the use of high production automatic machinery, especially in the bottling, packaging, labeling, wrapping and kindred fields, calls for added protection thru safety controls in power transmission equipment.

For this purpose we offer the Maxitorq floating disc Overload Release Clutch which automatically and instantly releases when the nature of an overload is either a heavy shock or suddenly applied load of a magnitude substantially greater than normal driving load. In such instances the machine mechanism may be clogged, products damaged and operator injured...all of which means expensive down-time.

The Overload Release Clutch performs most effectively and prevents heavy overload destruction. When jammed condition is cleared the clutch is re-engaged and operation continues. Simple fingertip adjustment sets the clutch to transmit normal running load. For original equipment, specify Maxitorq. There are six standard capacities, ¼ to 5 H.P. @ 100 r.p.m.

New catalog gives complete engineering specifications; shows complete line of standard clutches and driving cups.

ASK FOR CATALOG No. ME7

THE CARLYLE JOHNSON MACHINE COMPANY
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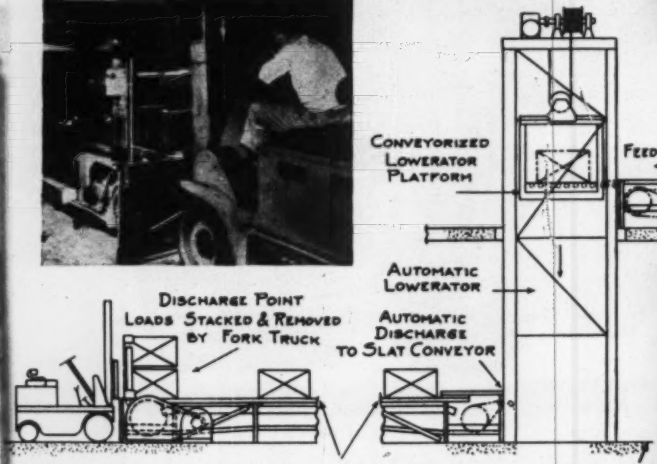
only through *Engineering*

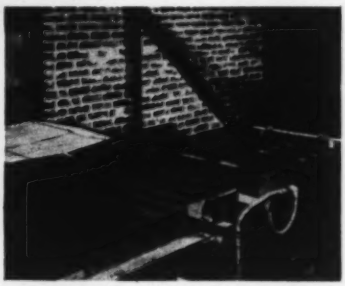
can *Efficiency* be achieved...

up 87½%

for department of a

LARGE EASTERN CAN COMPANY*





Like many foresighted manufacturing companies of today, this large eastern can manufacturing company, is constantly aware of in-plant materials handling as a major operating cost. The diagram and pictures present Gifford-Wood's solution to their problem of handling materials to storage. Long, empty return runs of the fork trucks used was only one aspect of the previous method of operation which was unduly expensive. Through the new G-W System, 2500-lb. bundles of steel sheets which formerly required eight hours to unload and store are now handled in one!

Working with Wigton-Abbott Corporation, Consulting Engineers, Gifford-Wood applied the materials handling knowledge for the solution of a costly problem—and this is only typical of many such engineered installations. All elements of such an installation (length of horizontal conveyor travel, raising or lowering to floors above or below, etc.) are, of course, designed to best suit the particular conditions encountered.

The G-W Materials Handling Engineer in your area will be glad to discuss the most economical means of materials flow in your plant. Call on him —it may well be the first step toward higher profits through lower operating and maintenance costs.

**Company name available on request.*

GIFFORD-WOOD CO.

Since 1814 • Hudson, New York

NEW YORK 17, N. Y. 420 LEXINGTON AVE. | ST. LOUIS 1, MO. RAILWAY EXCHANGE BLDG. | CHICAGO 6, ILL. 565 W. WASHINGTON ST.

When you think of materials handling—Think of Gifford-Wood

GE INSTRUMENTS — PRODUCTION TESTING

American Anode Recommends G-E Zahn Viscosimeter

"The G-E Zahn viscosimeter is so simple to use and clean that we recommend it to manufacturers who buy our latex mix for use in their own products," reports American Anode Inc., Division of B. F. Goodrich Co., Akron, Ohio, manufacturers of baby-doll skins, surgeons' rubber gloves, and similar equipments.

FLUID QUALITY CHECKED

"We furnish this instrument to buyers and licensees of our process" states Dr. Partridge, technical superintendent, "in order to insure proper control of the process." The Zahn viscosimeter is used to make daily tests of the latex solution enabling American Anode to maintain the required critical viscosity for their manufacturing process.

COSTS ONLY $12.87*

With the Zahn viscosimeter you can make viscosity measurements in approximately 20 to 40 seconds. It is so easy to use that no special skill is required to learn its operation. One-piece construction of the cup reduces any danger of breakage. The viscosimeter weighs only 4 ounces and is available with four different orifice sizes. Price is only $12.87*.

1952 CATALOG

G-E Measuring Equipment

80 pages describing all of General Electric's testing and measuring devices. For free copy check GEC-1016 in coupon at right.

U. S. Stamping Co. Standardizes Coatings And Cuts Costs with G-E Thickness Gage

The U.S. Stamping Company, Moundsville, W. Va., manufacturer of over 1200 different enamel-ware products, reported recently that by using G.E.'s Type B Thickness Gage, they are able to lower their manufacturing costs through quality control. "This is possible," a company representative explained, "because an excessive amount of enamel on a product causes flaking and chipping during the heating process, while if the enamel is too thin, it will burn. By using the thickness gage, it is a simple matter to maintain the correct enamel coating at all times. This greatly reduces rejects and enables us to standardize on coatings."

USED ON PRODUCTION LINE

Because the gage is portable and operates on any 110-volt circuit, the U.S. Stamping Company uses it right on the production line. The operator merely holds the gage head against the coating being measured and reads the thickness directly on the dial of the instrument. The coating is not scratched in this simple test and only the coated side of the material is touched.

WIDE MEASURING RANGE

The gage will measure the thickness of any non-magnetic materials on a magnetic base, and is available in ranges from 0.0002 to 0.10 inches. It is priced from $166.92* and up. Check coupon below for more information.

Vibration Indicator Cuts Testing Time 50%

Several large industrial concerns have reported recently that they have been able to reduce their testing time up to 50% through use of the G-E lightbeam vibration indicator.

PORTABLE AND ACCURATE

Portability and high accuracy combined with no setup time are features which make the indicator ideal for production testing as well as for locating vibration sources in machinery, gears and buildings.

WIDE RANGE—SELF CONTAINED

The vibration indicator operates on a self-contained battery with a life of about 700 vibration readings. Available in ranges of 15 or 30 mils over a frequency range of 15-250 c.p.s., it is accurate to ±3% of full scale. Price: $233.22*. Check coupon below for more information.

*Mfg. suggested retail price.

SECTION B605-19, GENERAL ELECTRIC
SCHENECTADY 5, N. Y.

Please send me the following bulletins:
Indicate:
√ for reference only
× for planning an immediate project

- ☐ Lightbeam Vibration Indicator GEC-853
- ☐ Thickness Gage GEC-319
- ☐ Zahn Viscosimeter GEC-339
- ☐ 1952 Catalog (GEC-1016)

NAME .....
COMPANY .....
STREET .....
CITY ..... ZONE ..... STATE .....

GENERAL ELECTRIC

WHAT *Life-Lines* REALLY DELIVER IS MORE SERVICE...LESS SERVICING

The way to grease modern motors is DON'T!

The modern, *pre-lubricated* Life-Line consigned greased fittings to the motor museum almost ten years ago—and did away with faulty lubrication.

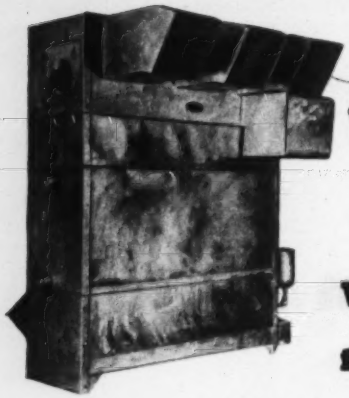
Think what it means. No more incorrectly greased motors. No failures from overlubrication, from under lubrication . . . from use of incorrect or dirty grease. Correct lubrication is sealed in . . . in advance.

Result? Longer motor life. Over a half million *pre-lubricated* Life-Line motors operating in every conceivable type of application have proved that outages from incorrect lubrication have been eliminated completely.

Take the case of an eastern manufacturer, for example. Motors were installed high on a press—out of reach of a maintenance man. Consequently, motor lubrication was forgotten. Bearings failed—windings burned. Then *pre-lubricated* Life-Lines were installed. Failures disappeared. Today, motors are still forgotten—but safely.

Remember, the way to lubricate a modern motor is don't. And, to spot a *truly* pre-lubricated motor, look for a motor that has *no* grease fittings. You'll *know* then it needs no greasing attention. You'll find your answer in Life-Lines.

Ask your nearby Westinghouse representative for a copy of "Facts on Pre-lubricated Bearings, B-4378", and for all the reasons why Life-Lines offer you more service on the job . . . less servicing. Or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21682



CARRIER AMMONIA
EVAPORATIVE CONDENSER

What's the modern solution to an old problem?

If you need refrigeration in a city or any other place where water is a problem, you'll be interested in the new Carrier line of Ammonia Evaporative Condensers.

Used in place of water-cooled condensers, they save as much as 95% water and 15% power costs. And because they require much less pumping head than cooling towers, you save from 75% to 90% in pumping costs, too.

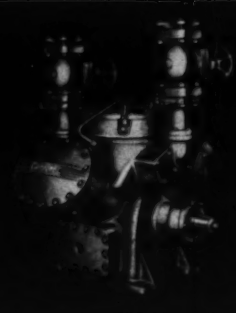
Hot dip galvanized after fabrication, they go indoors or outdoors. Sectionalized for easy installation, they offer a wide variety of applications and locations.

Carrier developed and introduced evaporative condensing in 1932. And today, Carrier offers this modernized line of Evaporative Condensers to meet the needs of industry where water is unusually warm or in short supply.

And remember, they are matched in size and performance to work with complete Carrier lines of Ammonia Compressors and Cold Diffusers. So when it's a question of ammonia refrigeration, Carrier is the place to come. Write for booklet specifying equipment you're interested in. Carrier Corporation, Syracuse, N. Y.

Carrier

AIR CONDITIONING
REFRIGERATION
INDUSTRIAL HEATING



CARRIER AMMONIA COMPRESSOR

CARRIER AMMONIA COLD DIFFUSER

Every small worm gear unit is built to precision standards—as outstanding in quality and performance as larger size Clevelands.
Illustrated above are the 10 AT (left) and 60 D (right) speed reducers.

Enjoy the benefits of worm gear drives in smaller CLEVELAND speed reducers

WHEN you want a quiet, powerful, dependable drive for a small machine, choose a Cleveland Worm Gear Speed Reducer.

As built by Cleveland, the worm gear reducer is a drive of many advantages:

1. It is compact and inherently quiet, transmitting power with smooth, uninterrupted torque flow.
2. Its right-angled design saves valuable space.
3. It has a minimum of moving parts.
4. Shock load resistance and other factors of safety are high.
5. Rate of wear of case hardened steel worm on nickel-bronze gear is very low, insuring long life.

Write for Bulletin 114F which illustrates and gives engineering data on smaller size Clevelands—many now available for immediate delivery. The Cleveland Worm and Gear Company, 3264 E. 80th St., Cleveland 4, O.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND

Speed Reducers

Specify Nordstrom Valves . . .

EXAMPLES . . . *Vegetable Oils, Caustic Soda,*

CARBON DIOXIDE—Cleveland paint maker installs Nordstroms on retort lines alternately handling carbon dioxide and vacuum. The six-inch Nordstrom at rear rotates with the tail pipe shaft.

COKE OVEN GAS—By-products plant in west has 12-inch gear operated Nordstrom valves on main line as safety shut-offs. Wide size range of Nordstroms makes standardization simple.

TALLOW—In this west coast plant of big soap manufacturer, four-inch three-way Nordstrom multiport valves control tallow lines to settling tanks.

VEGETABLE OILS—Crude oils from such nuts and seeds as sesame, copra, peanuts and soya beans are refined in California plant using Nordstrom valves on filter lines.

Keep Everything Under Control

Carbon Dioxide, Tallow, Lye, Coke Oven Gas

There are Nordstrom valves for hundreds of chemical applications. For instance:

- Three-way and four-way Nordstrom valves—in addition to the conventional straightway designs—are ideal for batching and blending lines.
- Special metals such as Type 316 Stainless steel, Nickel, Monel, Type No. 2 Ni-Resist, Nordco Bronze, Hastelloy B and Mercoloy are available to match the characteristics of nearly every normal chemical line fluid.
- A whole series of valve lubricants has been specially compounded for chemical service.

Chances are, whatever your process control problem, there's an easy-opening, positive-closing Nordstrom lubricant-sealed valve to solve it.

TYPICAL APPLICATIONS OF NORDSTROM VALVES IN THE PROCESS INDUSTRIES

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The new Nordstrom Corrosion-Resistant Valve Bulletin No. V-217 will make it easy for you to fit the right valve to each service. Rockwell Manufacturing Company, 400 North Lexington Avenue, Pittsburgh 8, Pennsylvania.

Write Today for Free Process Industries Bulletin, V-217

Rockwell Built Nordstrom Valves

Another Rockwell Product

LUBRICANT SEALED TO KEEP UPKEEP DOWN

CAUSTIC SODA—In Long Island plant, Nordstroms regulate caustic soda and caustic potash in manufacture of sanitary chemicals and deodorizers. Wrench shows open or closed position of Nordstrom valves at a glance.

LYE—Storage transfer lines handling lye are regulated through intricate flow pattern by Nordstrom multiport valves. Batching and blending processes are simplified with multiports.

How will that shiny new machine, appliance or equipment that you manufacture look after six months—a year—five years?

Will bolts and screws show ugly signs of rust? Will nuts corrode, so that their removal requires a hacksaw?

Harper Fastenings of non-ferrous metals and all stainless steels will solve your corrosion troubles—protect the equipment you manufacture throughout its life.

H. M. Harper is the world's largest exclusive producer of bolts, screws, nuts, rivets, studs, washers, cotter pins, of brass, naval bronze, silicon bronze, Monel, nickel, aluminum, and all stainless steels. Over 7,000 items in stock, bringing you these advantages:

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One order to write

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Harper distributors are located in every market area. Back of them is a vast reservoir of metallurgical experience and engineering skill to assist you in solving any corrosion problem.

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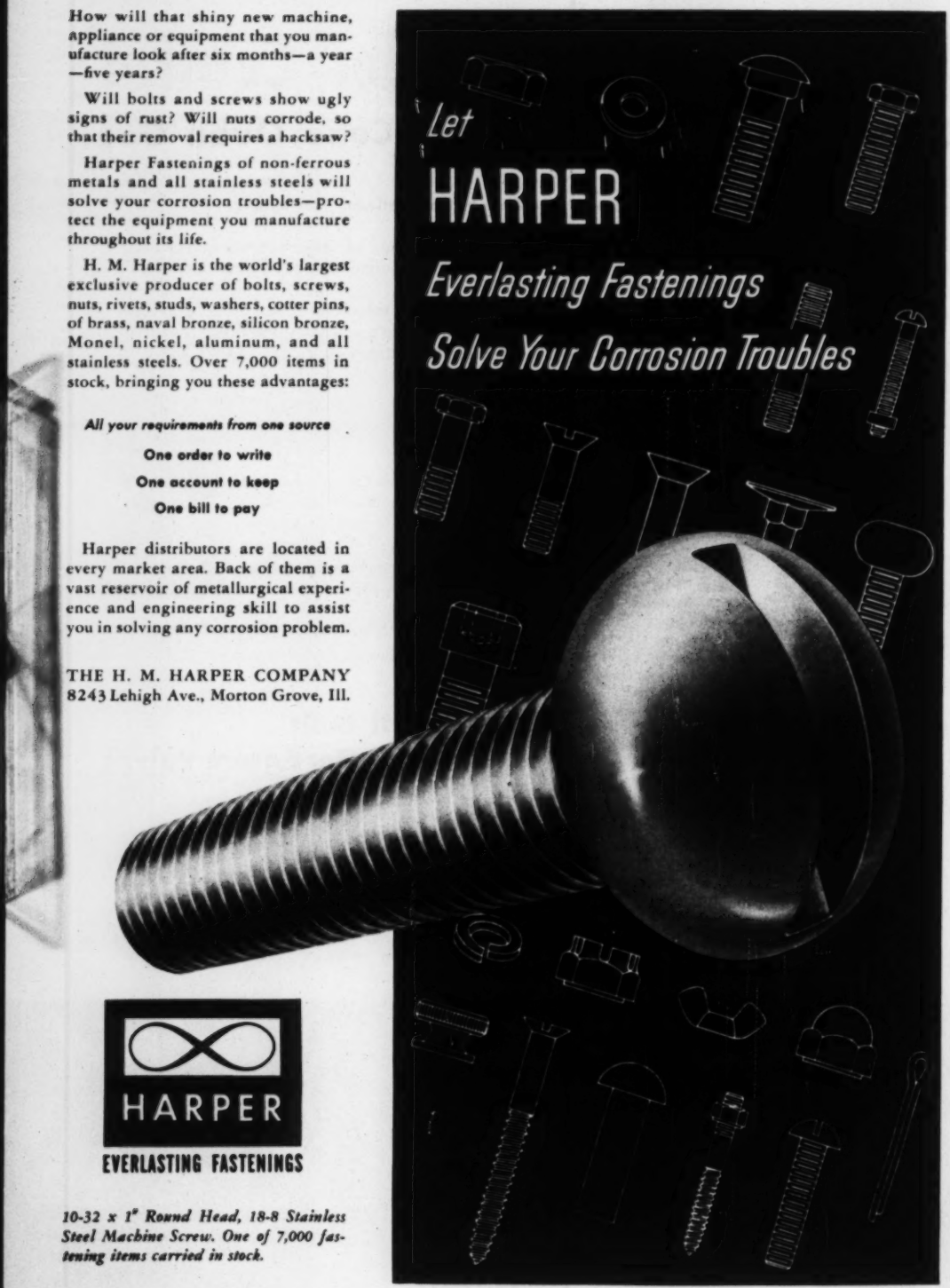

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10-32 x 1" Round Head, 18-8 Stainless Steel Machine Screw. One of 7,000 fastening items carried in stock.

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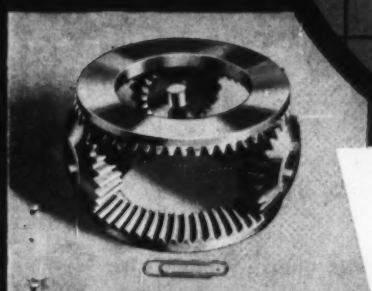
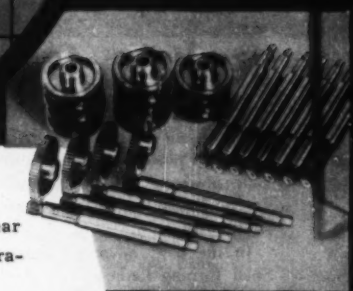
GEARS and GEAR DRIVES

electronic gearing





We invite your inquiry on gears and gear mechanisms for either manual or power operation of electronic equipment.

Our plants have the facilities and experience to provide comprehensive service, including special designs for your application as well as complete testing, manufacture, and inspection. Or we can provide economical production of circuit-control gears and gear drives to your specifications.

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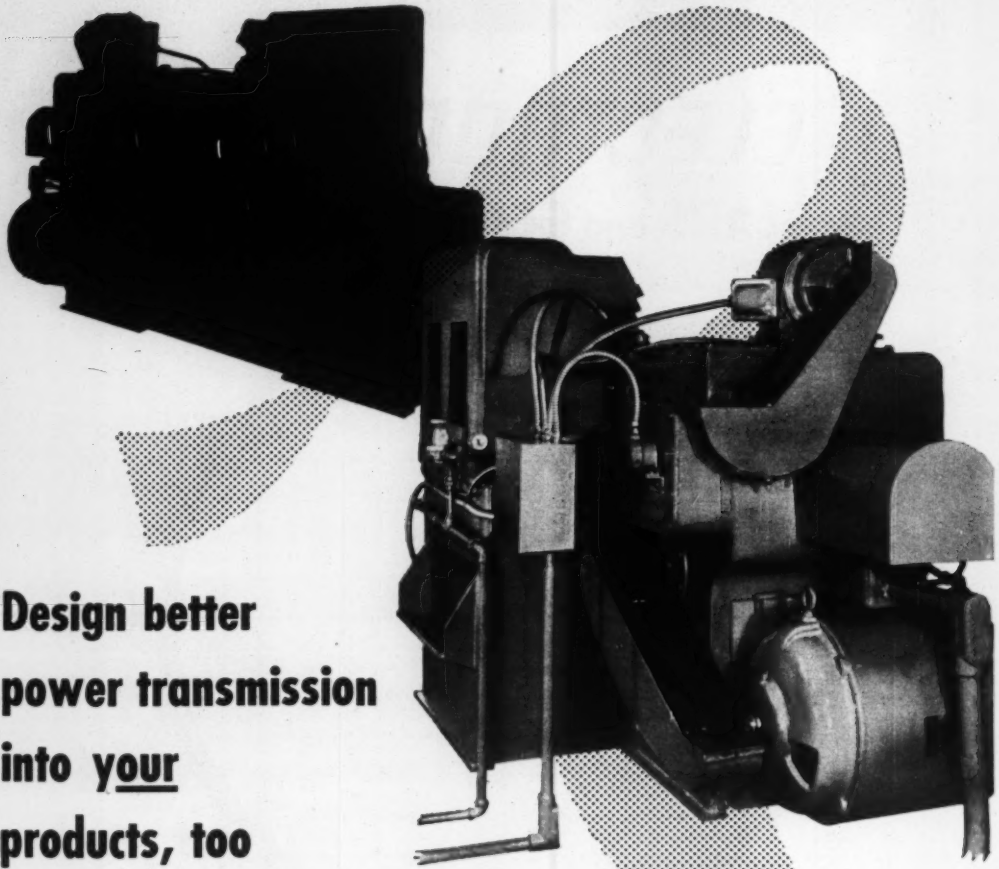

Design better power transmission into your products, too

You, too, can design more reliable, lower-cost power transmission into your products when you specify quality Morse Power Transmission equipment.

In the new, advanced Stamets Shell Turning Lathe shown above, a ¾"-pitch x 4"-wide Morse Silent Chain Drive functions as primary drive from 75-HP motor. The small carriage drive is a ½"-pitch x 1"-wide Morse Silent Chain Drive. Both drives are the result of Morse engineers working closely with Stamets engineers during lathe's design phase.

Morse Silent Chain Drives are built around the exclusive Morse Rocker Joint, which converts sliding action into rolling motion. The chains transmit power with more than 99% efficiency, can't slip. They reduce friction, heat, and noise. Morse Silent Chains give extra-long service life, with fewer service interruptions and lower operating costs — *proved* advantages delivered by all Morse Power Transmission Products.

Whether your need is for better power transmission through silent or roller chain drives, flexible couplings, drive shafts, or clutches, turn to Morse as Stamets has. Write us about any application you have in mind.

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MECHANICAL
POWER TRANSMISSION
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M = PT, Morse *means* Power Transmission

MORSE CHAIN COMPANY
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Midwest Shop-Fabricated Piping saves labor, time, money and trouble in erection. Subassemblies are always practical, with the difficult operations performed in the fabricating plant. Field welding is simplified as much as possible. All pieces are accurate in alignment and dimension . . . they are thoroughly cleaned to remove all scale and dirt . . . carefully inspected and tested . . . stress relieved when necessary . . . ready to erect quickly, easily at lowest cost. It is to your advantage to use Piping Prefabricated by Midwest.

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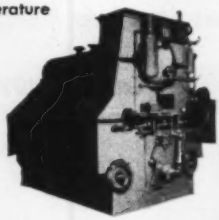
From the moment you place your order for a Wickes boiler, Wickes engineers and production men swing into action. They know that when you want a new steam generator, you want it fast and they rush production to get it to you. Wickes does the whole job, too—from the time the first drawings are made right up to the day you raise steam pressure. They build the boiler and they handle every last detail of installation. Then Wickes service takes over and continues for the life of the boiler. Wickes sales engineers and maintenance men in most principal cities are ready to serve you day or night.

Wickes can fill your requirements for steam generators up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers adaptable to any standard method of firing. Wickes boilers operate at a high degree of efficiency and owners' records show modest maintenance costs. Write today for descriptive literature or consult your nearest Wickes representative.



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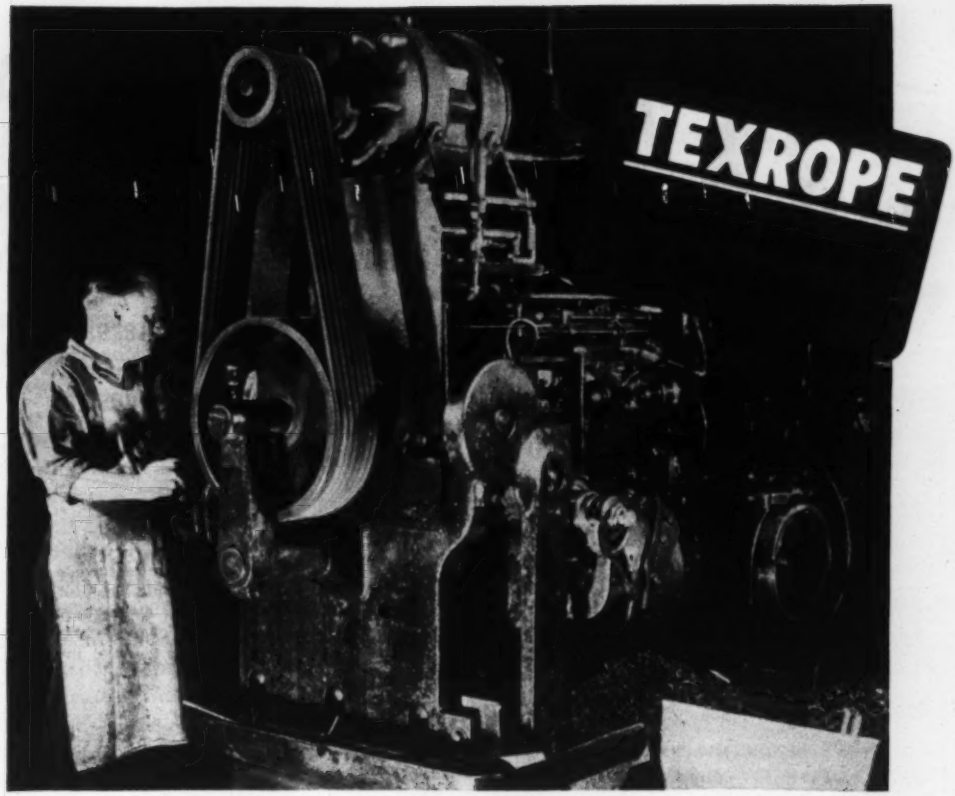
RECOGNIZED QUALITY SINCE 1854 **• SALES OFFICES:** Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Greensboro, N. C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D. C.



Check These 2 Ways to Cut Drive Costs

TEXROPE V-Belt Drives with low cost 1800 rpm motors will often do work of expensive motors and control.

For example you can:

1. Provide slow speed (such as 450 rpm) at the driven shaft using a standard 1800 rpm motor. A standard 4 to 1 *Texrope* drive will do it. And the savings over a 450 rpm cage motor, direct connected are:
   - 600 pounds weight (in 15 hp size).
   - About $200 in cost.
   - About 8% increase in efficiency.
2. Use *Vari-Pitch* sheaves on a *Texrope* drive and provide smooth, stepless speed adjustment. There's no need for a high cost special motor or electric control to provide up to 2 to 1 speed range.

For help on your drive problem, whatever it may be, call your nearby Allis-Chalmers distributor or district office, or write Allis-Chalmers, Milwaukee 1, Wis.

A-3734

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

Sold . . .
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MOTORS — ½ to 25,000 hp and up. All types

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

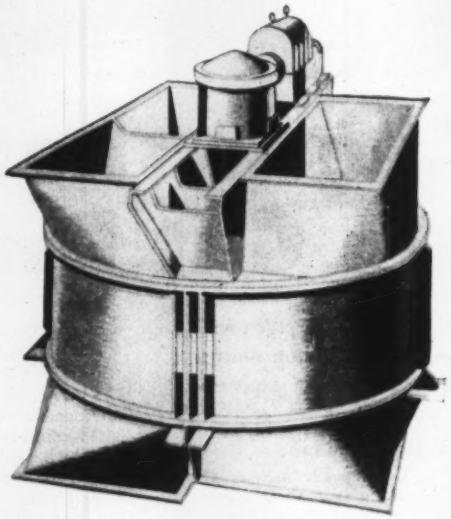
PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

ALLIS-CHALMERS

The Ljungstrom Air Preheater Can Help You

1. To improve combustion of low-grade fuels
2. To raise the level of heat recovery
3. To save materials in plant design

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.



If you want to improve the combustion of low-grade fuels . . . raise the level of heat recovery . . . conserve critical materials in plant design . . . you or your consultants can make profitable use of Preheater experience. Let our specialists tell you more about the Ljungstrom Air Preheater, and the outstanding job it has done for hundreds of America's leading industries and public utilities, where the need for preheated air from 300F to approximately 1200F was part of their problem. Our engineers are ready to work with you in applying the Ljungstrom to your own heat recovery problem.

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NEW!

High Speed
Low Price
Premium Prints

the COPYFLEX "30"

Here, for the first time, is a copying machine – Bruning's remarkable Model "30" COPYFLEX – that combines such a relatively *high speed* with such a *low price* and such *premium quality*, ready-to-use prints.

The "30" is ideal for the drafting room or office with medium volume requirements and a moderate budget. It handles cut sheets or roll stock up to 42 inches wide, and offers features ordinarily found only in larger, more expensive machines.

With the "30" and the unsurpassed line of sensitized COPYFLEX papers, cloths and films, you can always get the kind of premium prints you want, when you want them.

Why wait on inadequate equipment or for "outside" copying? See how the COPYFLEX "30" can save your time, cut your costs. Just send in the coupon *now!*

MODEL "93"—finest of copying machines. There's a COPYFLEX machine that's just right for every price and volume requirement.

Only *COPYFLEX* gives you all these advantages!

- Premium quality prints ready for immediate use
- No installation – simply make an electrical connection
- No fumes or exhausts because it uses no vapor developer
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BRUNING

Specialists in copying since 1897

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☐ Send me free booklet on COPYFLEX "30."
☐ Show me COPYFLEX in action (no obligation).

Name ..... Title .....
Company .....
Street .....
City ..... Zone ..... State .....

How Do YOU Score on

How do the drives from the power source in the machines you design score in this "driving" test?

	YES	NO
1. Do they transmit power positively and efficiently without costly slippage?	☐	☐
2. Do they assure positive, precise timing of machine operations . . . constant maintenance of speed ratios?	☐	☐
3. Do they have maximum shock absorbing ability?	☐	☐
4. Do they require only infrequent, low-cost, easy maintenance?	☐	☐
5. Are they compact . . . do they transmit large horsepower in limited space?	☐	☐
6. Are they sturdy and reliable . . . do not fail suddenly . . . will take abuse in emergencies?	☐	☐
7. Can they be lubricated for long life . . . are not affected by oil or grease?	☐	☐
8. Are they not affected by static electricity . . . free from fire hazard caused by overheating?	☐	☐
9. Are they the quietest medium obtainable in operation . . . free from vibration?	☐	☐
10. Are they simple to install and replace?	☐	☐
11. Are they long lived . . . of all-metal construction?	☐	☐
12. Do they allow for variations in shaft setting?	☐	☐
13. Are they free from pre-loads that shorten shaft bearing life?	☐	☐
14. Are they free from power loss, regardless of adjustment?	☐	☐

To find out how your drives rate, see opposite page.

This "Driving" Test?

Score seven points for every "Yes" answer. How did your drives make out? If you scored from 84 to 98 points, your drives are excellent, you're using the best drives for your machines.

You're using chain drives.

If you scored from 64 to 83 points, your drives are probably in good shape, but you'd better check them over for possible improvements in chain application.

If you're using any other power transmission medium, you can't possibly score more than 63 points. Isn't that good evidence that your best bet for lower cost power transmission . . . greatest design flexibility . . . greatest efficiency . . . *is chain.*

And, for the best in chain, choose from the complete Chain Belt Company line of Rex® and Baldwin-Rex® Chains. More than 2000 sizes and types offer you the greatest range of selection . . . permit you to pick the exact size and type that will best fit your requirements.

For lower cost . . . for greatest efficiency . . . for top quality . . . for best overall results from your machines . . . specify *chain* . . . from the complete Chain Belt Company line.

For assistance in the selection and application of chain for your machines, for best overall results, see or call your Chain Belt Field Sales Engineer. He's ready, willing and able to help you.

In addition, a large list of helpful literature is available for the asking. Here is a partial list of titles which may be of interest to you:

Care and Maintenance of Chains—Rex Lumber Mill Chains—Rex TableTop Chains—Rex Chains for Cement and Rock Products Industries—Rex and Baldwin-Rex Conveyor Chains and Attachments—Baldwin-Rex "BA" Riveted Roller Chain—Baldwin-Rex Stock Roller Chains—Baldwin-Rex Flexible Couplings—Baldwin-Rex Tension Linkages—Baldwin-Rex Double-Pitch Roller Chains—Unusual Applications of Roller Chain. Send for any or all of these booklets today. Chain Belt Company, 4765 W. Greenfield Ave, Milwaukee 1, Wis.

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Cone-Drive gears and speed reducers are "pre-shrunk" to fit them into up to ⅓ smaller space than you would normally have to allow for conventional gearing of the same load transmitting capacity.

The Cone-Drive manufacturing process sees to it that the worm is accurately wrapped around the wheel and the gear teeth in turn wrap around the worm.

This Cone-Drive "double-enveloping" design pre-shrinks a Cone-Drive gear set automatically to far smaller size than one would believe possible for the load it can carry.

To check this, just ask for the dimensions of a Cone-Drive gear set or reducer most nearly fitting your load and ratio requirements.

Then, if space-saving is one of your design objectives you can get a lot of help by simply reducing the gear space to match.

Available in many standard sizes and ratios, too.

CONE-DRIVE GEARS
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS

Division, Michigan Tool Company
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. . where space is a problem

. . . the Fairbanks-Morse Axial Air Gap Motor is the solution to your motor drive problems. For this unique motor is 40% shorter . . . 30% lighter than conventional models.

Like all motors that bear the Fairbanks-Morse Seal, the Axial Air Gap has the traditional strength, balance and electrical stability that assure you maximum service life.

Whether you are interested in a single motor, or thousands—one type and size, or a variety of types and sizes—you'll find that Fairbanks-Morse Motors are designed and built to fill your needs.

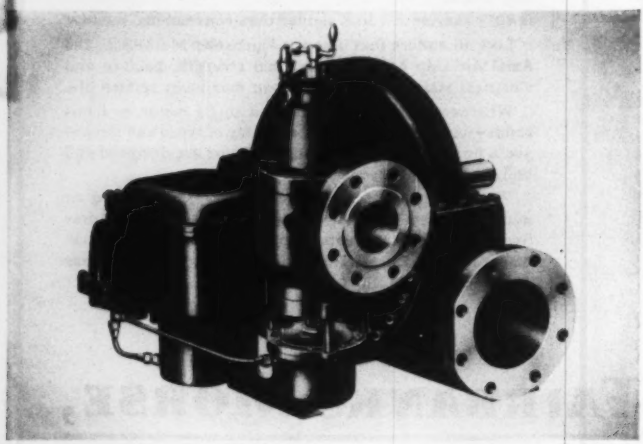
When you look for electric motors—for standard or unusual applications—*always* look for the Fairbanks-Morse Seal. For over 120 years it has stood for the finest in manufacturing integrity to *all* industry. Fairbanks, Morse & Co., Chicago 5, Ill.

FAIRBANKS-MORSE,

a name worth remembering

ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • PUMPS • SCALES • HOME WATER SERVICE EQUIPMENT • RAIL CARS • FARM MACHINERY • MAGNETOS

Mr. A. Bourgeois, process foreman at Sohio Refinery, adjusts pump valve. Type DP-20, 125 hp turbine increased by 75% the oil thru-put of this pump which supplies crude oil for the distillation unit.



Type DP MECHANICAL-DRIVE TURBINE

This Type DP turbine is one of General Electric's line of mechanical-drive turbines designed for driving pumps, compressors, blowers, etc. Their sturdy construction and many safety features make them ideal for industries having process steam requirements.

At Sohio's Toledo Refinery, this 15 hp, Type DP-16 turbine with non-sparking enclosed overspeed governor, safely pumps propane in an explosive atmosphere.

Mr. Eugene Ten Eyck and Mr. E. J. Bissonnette of Sohio Refinery discuss stocking of interchangeable parts for the Type DP turbines installed at the Refinery.

Sohio Refinery picks G-E turbine drives to increase oil thru-put

Engineers at Sohio's Toledo Refinery installed two G-E mechanical-drive turbines to help eliminate a bottleneck in refinery operations. A General Electric Type DP-20 turbine increased oil thru-put on one pump at Sohio by 75%, when it replaced older drive equipment. Total daily thru-put of the one pump now equals the former capacity of two pumps.

INSTALLED IN HAZARDOUS AREA

Sohio also installed a G-E Type DP-16 turbine in an explosive atmosphere to pump almost pure propane. The enclosed, non-sparking overspeed governor and the positive trip-throttle valve (which shut off all steam flow in case of overspeed) reduce hazards in this area. The turbine, which operates twenty-four hours per day, has required no maintenance during its first year of service.

VIBRATION REDUCED

Replacement of previous drive equipment with a G-E turbine now assures longer life to other machinery in the area. For G-E turbines with their center-line support and rigid assembly of buckets are now contributing to smooth operation at the refinery.

INTERCHANGEABLE PARTS

Use of G-E standard turbines can make stocking of spare parts a simple matter—most replacement parts are interchangeable among various frame sizes of G-E Type DP turbines. Stocking costs are cut, yet parts are available when needed.

This same parts standardization adds to the turbine's flexibility—often the turbine can be adapted to a new plant application with only minor adjustments. Horsepower range can be changed by substituting a different nozzle plate and valve parts.

For more information about the many advantages which these standardized turbines offer, call in your G-E sales-engineer or write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." Section 252-56, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

COMPARISON OF GRATE MATERIAL

Gray iron sintering grates, at left, show bad scaling and warpage after a single month of use. Note good shape of Ductile Iron grates, above, after same service. They greatly outlasted gray iron grates.

DUCTILE IRON FURNACE DOORS SAVE MONEY, TIME AND LABOR—In ordinary iron, exposed to high temperature, internal oxidation easily penetrates along paths of flake graphite, thus causing destructive growth. Penetration is curbed in Ductile Iron, since its graphite is wholly in spheroidal form.

DUCTILE IRON Sintering Grates and Furnace Doors

excel in elevated temperatures

Performance Records Show Outstanding Heat-Resistance of this New Material.

Tests show that iron containing graphite wholly in spheroidal form provides notably greater growth resistance than ordinary gray iron.

FOR INSTANCE: Gray iron and Ductile Iron grate bars in the Greenawalt sintering system of a merchant pig-iron producer gave the following performances:

At the Canadian Furnace Company, Ltd., in Port Colborne, Ontario . . . from date of their installation, August 1950, to June 1951 . . . no Ductile Iron grates needed replacements although 150 gray iron grates had to be replaced after 6 weeks' service.

The sinter-plant foreman stated, "*The Ductile Iron grates still seem to be as good as new.*" Cast by Lakeside Foundry, Ltd., of Port Colborne, these Ductile Iron grates also out-performed steel grates tested previously.

ANOTHER EXAMPLE: The forging furnaces of a leading steel plant now have Ductile Iron doors supplied by United Engineering and Foundry Company, Pittsburgh 22, Pa. Gray cast iron doors which were subjected to 24 hours' continuous service daily, heat-cracked after an average life of about four weeks. A trial lot of annealed Ductile Iron doors lasted 17 weeks . . . or more than four times as long as those of gray cast iron.

APPLICATIONS: As cast, as well as heat-treated Ductile Iron parts . . . serving at elevated temperatures in scores of machinery, engine and furnace applications . . . provide a growth-resistance heretofore unavailable in gray cast iron.

AVAILABILITY: Send us details of your prospective uses, so that we may offer a list of sources from some 100 authorized foundries now producing Ductile Iron under patent licenses. Request a list of available publications on Ductile Iron . . . mail the coupon now.

The International Nickel Company, Inc.
Dept. ME, 67 Wall Street, New York 5, N. Y.

Please send me a list of publications on:
DUCTILE IRON

Name_____ Title_____

Company_____

Address_____

City_____ State_____

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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 74 NUMBER 7

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X-Ray Gage Controls Thickness of Sheet and Strip

[Thickness of sheet brass, copper, and commercial bronze rolled on 4-high mills in Chase Brass & Copper Company's mill in Waterbury, Conn., is controlled by x-ray gage to within 0.001 in. Mill operator (right) watches dial (above hand of man at left) and expertly corrects position of rolls when dial hand wavers from center position, thus insuring uniform thickness of product.]

VOLUME 74
No. 7

MECHANICAL ENGINEERING

JULY
1952

GEORGE A. STETSON, *Editor*

ASME Boiler Code

SEVERAL years ago there was submitted for publication in this magazine a brief statement of the origins of the ASME Boiler Code. To many younger engineers this statement might have sufficed to acquaint them with a few significant facts and dates. To many older engineers, these simple facts were already known. What was not known to all but a very few of the men still living who took an active part in the development of this remarkable segment of the history of The American Society of Mechanical Engineers and what has never been available except in the records of the Society was the complete story—the background of conditions as they existed before the Code was adopted; the long and arduous campaign, some of it carried on in an atmosphere of skepticism as to its probable success; and the developments of nearly four decades of continuous work by hundreds of engineers through which the Code was established, accepted by engineers, manufacturers, users, insurance companies, and government inspection services, and made a vital and up-to-date document, reflecting progress and changes in materials, construction methods, and advancing practice in the generation of steam. It was to provide this complete story that means were sought to bring together the great mass of available material and organize it in such a manner that the significance and tremendous importance of the ASME Boiler Code would be a matter of permanent public record. To undertake this task, the ASME Boiler Code Committee was fortunate in enlisting the services of Arthur M. Greene, Jr., who had himself been closely associated with the Boiler Code Committee almost from its very start. Publication is begun in this number.

It may be difficult for some younger engineers to believe that opposition to or doubts about the success of a boiler code could exist or that any spirit except that of greatest enthusiasm could greet proposals to eliminate the chaotic conditions that existed prior to the adoption of the ASME Boiler Code. With no nationwide standard, manufacturers were forced to construct boilers in accordance with codes which differed so essentially that a boiler constructed in accordance with one code would not be acceptable in another community. Materials, safe stresses, methods of construction, safety valves, and other elements of boiler manufacture differed widely. Loss of life, injuries to persons, and destruction of property because of boiler failures called for strong measures. Interests of manufacturers, users of boilers, insurance companies, boiler inspectors, and the public in general had to be considered and brought into harmony. With representation of all of these interests on the committee which wrote the first Code, differences of opinion were composed and confidence in the fairness and workability of the Code was established. And as the Code became effective, the serious task of interpreting its meaning and keeping it up to date became a responsibility of the Committee and the Society. The task was not an easy one. From time to time crises arose which might have spelled defeat. But the system was a good one and the devoted men who administered it were patient and wise. Today the Code stands as an impressive example of the successful working of the American system of free enterprise at its best.

Theme for the Centennial

IT is the announced intention of the Centennial of Engineering, to be held in Chicago, Sept. 3–13, 1952, in commemoration of the one-hundredth anniversary of the founding of the American Society of Civil Engineers, "to demonstrate that an atmosphere of freedom and competition, with competent engineering and management in industry, is essential to maintain and increase the prosperity of the nation." More than fifty engineering societies and organizations are co-operating in this significant event, and the free world hopes that the high intentions of those who are planning the programs will be successful in proving the validity of this faith to the rest of mankind.

In the world as we see it today the "atmosphere of freedom" is heavily charged with ideologies and tensions that are antagonistic to us. This atmosphere of freedom, which seems so natural to us, that was created for us more than three centuries ago, has never been found in a very large sector of the world; and in many places where it has been established it has been short-lived. The complacency of most American citizens at the turn of the century, when it was generally assumed that liberty and the American version of democracy would spread throughout the world as though it were a natural and inevitable process of societal evolution, has been rudely disturbed. Two wars and world-wide economic depressions, the shrinkage of distances resulting from advances in communications and transportation, and the emergence in militant form of other philosophies of government and morals, have awakened us to the size of our task and to the danger that we may lose what we so proudly and ardently profess as being a better way of life. At no time has it been more important for us to proclaim and propagate our faith, and

hence it may be that the Centennial of Engineering will become a milestone in the evolution of civilization.

We should remind ourselves that the men who settled our country found in their religious convictions the basis for the government we now enjoy. The charter of our liberties is the Mayflower Pact, signed in November, 1620. In it the signers "do by these presents solemnly and mutually in the presence of God and one of another, covenant and combine ourselves together into a civil body politic . . . . and by virtue hereof to enact, constitute and frame such just and equal laws, ordinances, acts, constitutions and offices, from time to time, as shall be thought meet and convenient for the general good of the Colony."

Eighteen years later Thomas Hooker was to declare that "the foundation of authority is in the free consent of the people" and that each man derives his rights "according to the blessed will and law of God." Thus, in the spirit of the Pact and urged by the vehemence of Thomas Hooker's sermon, the General Court, in 1639, promulgated a written constitution, the Fundamental Orders, under which Connecticut was governed for 35 years. The same principles were later written into a Royal Charter, the basic document of democratic constitutional government for 150 years, which the people of Connecticut refused to surrender to the King, a document that was the prototype of the Constitution of the United States. The town meeting at which every man could speak his mind, levy his taxes, and vote public expenditures; the federation of towns—one town, one vote—in which a group of communities organized themselves for mutual benefit; the public-school system, which provided educated young people fit to assume the responsibilities of self-government; and the rapid spread, from 1636, of institutions of higher learning for the training of men for leadership in church and state—these and the common law were the elements which insured success to the American democracy. They constituted the mold in which the United States of today was cast. They created the "atmosphere of freedom" which today, we claim, "is essential to maintain and increase the prosperity of the nation."

What basis have we for thinking that the engineer, more than any other citizen, has talent and responsibility to advance the cause of liberty and democracy?

Early in its history The American Society of Mechanical Engineers decided that the profession of engineering harbored a strong public-service motive, that the interests of its members would extend beyond the bounds set by a strict adherence to the technical phases of their work, and that, by virtue of the positions they held in industry, they were particularly obligated to exercise their talents for the general welfare.

This greater responsibility was felt and the engineers' response to it was voiced by Dr. Robert Henry Thurston, first president of the Society, in an inaugural address delivered at the first Annual Meeting in November, 1880. "The Society will have much work to do as a union of citizens having important interests confided to them," he said in that memorable address, "and its province will be no less in the field of social economy than in that which has reference only to the individual interests of its members." He deplored the fact that businessmen had been unable "to influence legislation in relation to matters directly bearing on the business interests of the nation," and said that "this will be corrected when businessmen have learned to organize and act concertedly whenever the business of the country is liable to be affected by legislation. It is their right to be heard fully and patiently, and it is their duty to take such action as will secure for them due consideration." He believed in the "atmosphere of freedom," and in the duty of the engineer to maintain it.

The belief that a portion of the work of the Society would lie "in the field of social economy," was put to its first test in 1886 when Henry R. Towne, apparently with some misgivings as to how it would be received, delivered at Chicago a paper, "The Engineer as an Economist." Favorable reception led him to comment some months later that "it is more appropriate for this Society to consider such matters than any other of the engineering societies. We have in our membership," he continued, ". . . men who are managers of labor, who are either owners or representatives of owners who therefore control capital. . . . These economic questions come nearer to us and to a larger number of our members, and in my judgment they can most properly be considered, to a reasonable extent, germane to the interests and duties of a large proportion of our membership."

In such terms did the acute vision of Henry R. Towne forecast the great role engineers were to play in grappling with the problems of a rapidly expanding industrial economy. But another twenty years passed before a flowering of experience and study served to enrich the publications of ASME with papers on these subjects and earned for engineers acknowledgment of their achievements and competence in these fields. Taylor, with his rational basis for management, was to lead the group. Dodge, who had faith in Taylor and Barth, showed the way in manufacturing plants; Gantt, the philosopher and consultant, devised means of production control; the Gilbreths, with their principles of time and motion study, increased efficiency and reduced fatigue; Wallace Clark took the American "know-how" in management and production to a war-devastated Europe; Kimball introduced industrial engineering into college textbooks; Alford, the great editor and publicist of the new order, wrote the handbooks. These and hundreds of their contemporaries and disciples have provided the means and the inspiration through which engineers have developed the opportunities foreseen for them by Thurston and Towne and thus enlarged the debt America already owed to those who were prolific in invention, advanced the mechanics arts, and labored in the more traditional fields of applied science and technology. It is these men and their work that should be recalled at Chicago next September, for their leadership in showing the way toward "competent engineering and management in industry." "The atmosphere of freedom" and the great benefits to humanity which engineers have developed in it, is a worthy theme for the 1952 Centennial of Engineering.

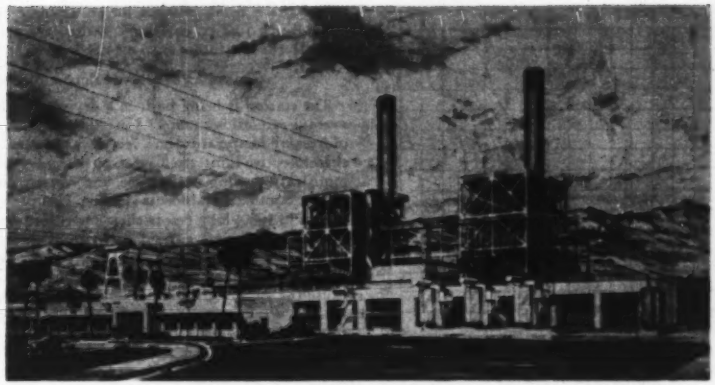

FIG. 1 ARCHITECTS' RENDERING OF ETIWANDA STEAM STATION

ETIWANDA—*A Study in Over-All* STEAM-STATION ECONOMY

By W. L. CHADWICK[1] AND E. H. KRIEG[2]

HOW has it been possible for the electric-utility industry to continue in business and even expand in the face of increased taxes and operating costs?

The four most important elements in the cost of energy are taxes, fuel, capital, and labor. In 20 years, taxes of electric utilities in Southern California have jumped from about 1.5 mills per kwhr to almost 4.0 mills at present. Fuel-oil costs, during this period, have climbed two to three times. With "big-inch" and "super-inch" lines now carrying natural gas to big population centers for heating, the cost of this fuel is rising rapidly. Even the cost of "dump gas" is increasing. In a few cases, such as those where strip mining and water transportation are possible, coal costs have decreased but most operators find them materially higher. Construction costs have advanced along with the marked increase in the cost of all labor. Construction wage rates, with related payroll taxes and the new fringe costs, have soared about 4.5 times since 1930. The cost of materials and equipment has climbed along with labor, as shown in the cost index of power-plant construction, Fig. 2. Operating labor costs have increased along with construction labor costs.

Although the average rate for money is appreciably lower than 20 years ago, so much more is now required for a given job that the benefit of lower money rates is largely lost. Yet, without being able to raise electric rates to offset these costs as they rise, the industry must raise more capital in less time than ever before—currently, more than two billion dollars a year for new facilities. To raise new capital, a fair return must be assured the investor. How then has it been possible for the industry to continue in business? There is no single answer, but certainly one of the most important is the ingenuity which has been exercised in the engineering, design, and consti ion of generating plants which continually lower fuel consum, ion while providing higher availability with lower operating and maintenance costs.

Economy in power-station design and construction has never been so critically essential to the electric-utility industry as it is today. It was early resolved that the new Etiwanda Steam Station, now under construction, should meet the challenge of higher costs by careful attention to the economy of all components.

ECONOMY AS A DESIGN AND ENGINEERING ATTITUDE

Among others, the following criteria for engineering and design were established:

The design should have the greatest simplicity, ruggedness, and economy consonant with reliability and efficiency.

First cost is important but should not be considered paramount, the objective being the over-all optimum combination of investment, fuel, labor, and maintenance costs consistent with maximum availability.

The most favorable fuel costs should be obtained by burning the fuels in the area, i.e., oil and whatever natural gas might be available, but the design should provide space for the installation of future coal-handling, pulverizing, and burning equipment should coal at some time become the more economical fuel. However, no avoidable investment should be made for future coal burning.

[1] Vice-President in Charge of Engineering and Construction, Southern California Edison Company, Los Angeles, Calif. Mem. ASME.

[2] Consulting Engineer, Stone and Webster Engineering Corporation, Boston, Mass. Fellow ASME.

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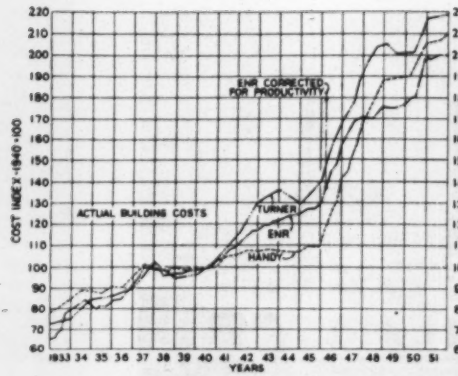

FIG. 2 UTILITY SYSTEM COSTS IN 1951 WERE ABOUT 110 PER CENT HIGHER THAN IN 1940

(The Handy-Whitman Index is for public-utility construction costs. The ENR Building Cost Index reflects material and wage-rate price trends without adjustment for labor efficiency or similar factors. *Engineering News Record*, November 1, 1951, and March 29, 1951, presents a more complete story.)

Investment in all facilities that are not directly concerned with power generation should be minimized. To this end, a fully outdoor design was adopted, and Fig. 1, shows how minimum use of buildings can present a functional and attractive appearance.

The Southern California Edison Company system, Fig. 3, is changing from a predominantly hydroelectric system, principally because the more economical hydroelectric sites have been developed. Sufficient base load now exists to warrant the installation of high-efficiency, reheat steam-electric plants whereas, formerly, low annual load factor limited steam plants to moderate pressures and temperatures.[3] In these earlier plants quick pickup from minimum to maximum load was required, a problem which the company solved by the pioneer development of extremely wide-range oil burners. The system now has 748 mw of capacity, designed and adapted for quick load pickup; hence a new plant could be planned to exploit the improved load factor.

SELECTION OF SITE

The Etiwanda Steam Station is being built in the heart of the growing Fontana industrial area, about 50 miles east of Los Angeles. Ocean-front sites, and other inland locations were considered, but the Etiwanda site, shown in relation to the system in Fig. 3, was selected for the following reasons:

It is in a rapidly growing industrial area where no fuel-burning plants now serve the Edison system.

The area is still open for industrial development with favorable zoning.

A desirable dispersion of stations is attained.

Excellent transportation facilities, both rail and highway, now exist.

Ample water make-up for cooling towers is available from the nearby main upper feeder of the Colorado River aqueduct, and good underground water is available in sufficient quantity for boiler make-up.

Existing 220-kv rights-of-way provide routes for additional 220-kv circuits.

[3] "Steam-Electric Power Expansion in Southern California," by W. L. Chadwick, Trans. ASME, vol. 72, 1950, p. 223.

The site is being laid out for an ultimate 550-mw capacity, but only two units, totaling 250 mw, are presently being installed; the two future units may be larger.

STRUCTURES AND ENCLOSED SPACES

The station is being built in a dry warm climate where the average rainfall is about 17.5 in. per year with only a few hours of freezing temperature on a few days per year. It was natural, therefore, to limit enclosures to the control room, the administration, shop, warehouse, and water-treatment buildings.

The Southern California Edison Company pioneered heat pumps in 1930, long before their currently popular use, and the same thinking was carried forward by heating and air-conditioning certain enclosed areas with heat pumps. Study was made of both common and separate pumps. However, because the administration building will be occupied only about 40 hr a week, compared with 168 hr a week for the control room, it was found more economical to use a large pump to serve the former and a small one for the latter. The air-conditioning design criteria are to hold the office temperature in the warmest weather 20 F below the ambient and the control room 18 F below. To reduce the load on the air-conditioning system, sunshades, Fig. 4, are being built over the administration-building windows which will prevent direct sunlight entering the rooms but admit plenty of reflected light.

Minimum use of enclosures greatly simplified the ventilation problem, resulting in an estimated saving of over $75,000 for ventilating fans. Consideration was given to the use of "walk-in" enclosures over the turbine generators, but it was realized that the high ambient temperatures present during summer weather plus radiation from machine parts would, without excessively expensive cooling equipment, make these spaces as "stifling" as the inside of a closed automobile standing in the summer sun.

Two additional advantages of the outdoor construction are anticipated: one, a saving in clean-up labor through ability to wash down floors and equipment when necessary; the other, a gain in safety.

It is estimated that the total saving through elimination of the usual boiler and turbine buildings will be between $5 and $8 per kw or $1,250,000 to $2,000,000.

At a considerable economy over the cost of alternatives, "tilt-up" concrete construction is being used for the one-story administration building where maximum use also will be made of formed surfaces for final finish. The walls are of concrete, cast and cured horizontally, using ready-mixed concrete, then "tilted-up" into position and the sections joined together.

All structures were designed for a seismic factor of 0.2 gravity.

The 60-ton main gantry crane was selected to handle turbine parts and the generator field but not stator. The latter need only be handled once; it will be cribbed into place. As a result, the cost of cribbing, equal to the carrying charges on the larger crane, will be saved each year.

Subsurface construction has been kept to a minimum. Because of the very favorable natural ground conditions and by using carefully compacted fills, forms were not necessary when casting column footings and most subgrade concrete.

SIZE FACTOR AND DUPLICATE INSTALLATIONS AS MAJOR ECONOMIES

Keen appreciation of the savings afforded by using large units influenced the selection of the largest 3600-rpm tandem-compound turbine-generators being manufactured at the time, even though none was then in operation. The incremental cost of 125 mw over 100 mw capability units is less than the ratio 1.25 to 1. By designing and installing simultaneously

FIG. 3 SYSTEM MAP OF SOUTHERN CALIFORNIA EDISON COMPANY SHOWING LOCATION OF ETIWANDA STEAM STATION

two 125-mw units, each on a unit basis, substantial reductions also are being made in engineering, purchasing, and construction. Engineering and drafting work is simplified for two units, purchasing for two units costs less, and, by having the second unit follow the first immediately, major reductions are possible in construction costs as men have been trained and solutions to many problems have been developed.

HEAT CYCLE

Once the heat cycle of a steam-electric station is determined, its fuel requirements are frozen, because a change in fuel cost seldom justifies a change in the heat cycle of an existing plant. Frequently, insufficient time is available in which to study this most important design decision, and all too often it is left to the turbine manufacturer to suggest what heat cycle should be

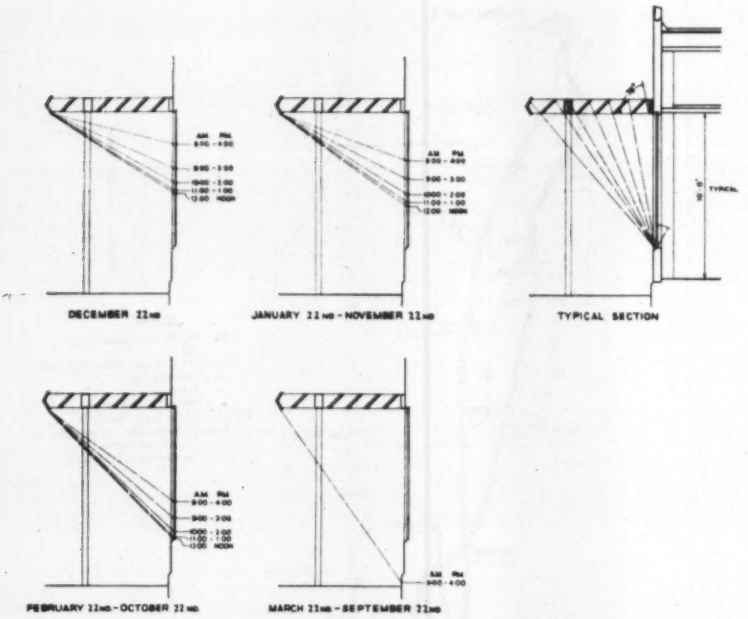

FIG. 4 SUNSHADES OVER ADMINISTRATION-BUILDING WINDOWS PREVENT DIRECT SUNLIGHT ENTERING ROOMS, THUS REDUCING AIR-CONDITIONING LOAD WITHOUT DARKENING THE INTERIORS WHICH RECEIVE AMPLE REFLECTED LIGHT

used, regardless of the fact that he cannot investigate the many economic angles involved. The heat cycle is only one element in a complex of many factors requiring study; such as, hours of operation per year at various loads, optimum number of turbine-exhaust flows, optimum size of condenser and cooling tower, and differential costs of various steam pressures and temperatures, keeping in mind that the vital fuel cost is not only today's, but a composite of today's and those of 10, 20, and 30 years from today.

Fig. 5 shows the heat cycle that was eventually developed to achieve a happy medium between high fuel efficiency and the fact that high fuel efficiency means nothing to a plant that is shut down.

Because of widespread experience with the fouling of closed low-pressure heaters, which have caused initial heater-terminal differences of 5 F to increase to 15 F and even 30 F, it was early decided to use an open deaerating heater at as low a pressure as would be economical. This arrangement had been used before with satisfactory results, e.g., at Buzzards Point plant of Potomac Electric Power Company. In addition to the objective of maintaining a close terminal-temperature difference for the heater at a stage where it means the most, it also was desired to decrease the static head between the deaerator and the primary boiler feed pumps for the following reasons:

To eliminate the expense of heavy steelwork required to support the heater at the usual 50 or 60 ft above the feed pumps, such as is required when a 50-psi heater is used.

To reduce the cost of earthquake bracing needed for a heavy deaerator at a high elevation.

The deaerator was finally placed at the next to lowest bleed point, which is at a pressure of 1 psig or higher when the unit is operating at 80 per cent turbine capability and above. This arrangement minimizes the low-load venting problem and decreases the cost of air-removal equipment.

By placing the lowest-pressure, or 6-psia, closed heater in the condenser neck so that piping between the turbine extraction connection and the heater inlet is only 4 or 5 ft long, the decreased bleed-piping pressure drop has the effect of gaining 1 or 2 F on the heater terminal difference.

The complete study made to determine the most economical terminal-temperature differences for the heaters and drain coolers led to the decision to use the following values at 125-mw load:

Heater no.	Condensate terminal difference	Drain cooler TD
1 (highest pressure)	−3	10
2	−3	10
3	0	10
4	+3	10
5 (deaerating heater)	0	None
6 (lowest pressure)	+4	10

The heat rate with 2 in. Hg back pressure is expected to be around 9540 Btu per kwhr sendout when operating on oil fuel and after full charge for the power needed for all auxiliaries, including the cooling-tower induced-draft fans.

TURBINE GENERATOR

Selection of initial steam conditions and number of exhaust flows being the first decision necessary preparatory to the selection of other equipment, detailed cost analyses were made to determine the most economical combination of initial steam

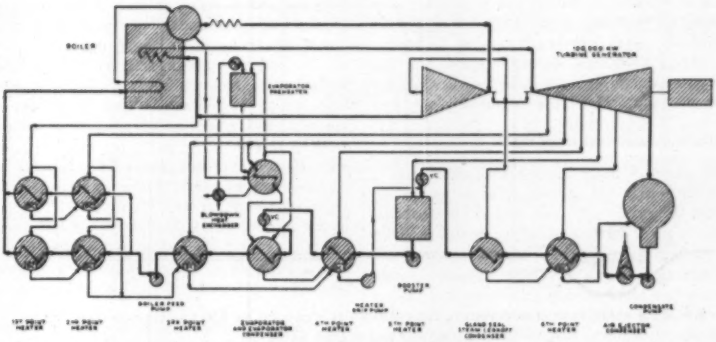

FIG. 5 ETIWANDA HEAT CYCLE SHOWING DEAERATOR AT 15 PSIA BLEED POINT AND TWO STREAMS OF HEATERS FOR TWO HIGHEST-PRESSURE BLEED POINTS

conditions, cooling-tower size, condenser size, and number of turbine flows, i.e., whether double or triple. Further, the use of a cooling tower made it necessary to study the economics of the combination simultaneously, as a change in any one of these variables definitely would affect the choice of the other variables. The optimum combination was found to be as follows:

Initial steam conditions of 1800 psi, 1000 F with 1000 F reheat.

Triple-flow exhaust (partially justified in anticipation of outputs somewhat higher than 125 mw).

Cooling tower with 14 F approach, giving 72 F water with a 58 F wet bulb.

80,000 sq ft condenser for yearly average vacuum of 1.65 in. Hg.

A special study was made by the General Electric Company on turbine-generator appearance, including preparation of a model that served as a prototype for many other units, because it was believed that a machine, costing several million dollars, should "look like a million dollars."

Among other means utilized to obtain economy is an unusual emergency stop-valve arrangement which permits vertical and axial, but no lateral movement, both simplifying and minimizing the cost of the main steam leads as well as the piping between the stop and control valves. A shaft-end house generator will be provided on each unit.

BOILER

The boilers were first purchased for natural circulation. The subsequent specification of controlled-circulation boilers was based on economic comparisons which included both purchase price and the comparative cost of supporting steelwork.

Controlled circulation facilitated the use of 1800 rather than 1450-psi turbine-inlet steam pressure. The 3-in-OD tubes normally furnished with 1800-psi natural-circulation boilers are suitable for 2010 psi, whereas the 1.5-in-OD tubes of the controlled-circulation boilers are suitable for a pressure of 2332 psi. With negligible cost for thicker drums, 1950-psi superheater-outlet pressure, or 50 psi above that available with natural circulation, was obtained. Being able to allow 50 psi higher pressure drop in the main steam leads made possible the use of 10.5-in-OD rolled tubing, rather than larger-diameter forged and bored tubing costing about $150,000 more. As controlled-circulation boilers employ tubes of smaller diameter with correspondingly thinner wall, and lower skin temperatures, it is hoped that maintenance may be somewhat less and availability somewhat higher.

Controlled circulation also makes it possible to provide water-cooled spacers for the superheater and reheater which should reduce attack by fuel oils producing metallic oxides, particularly those of vanadium. Elsewhere such fuel oils have caused serious maintenance of superheater spacers even when the latter are made of 25 chrome - 12 nickel alloy.

Other advantages considered for controlled circulation are as follows:

The boiler is about 13 ft lower and about 125 tons lighter, which is an advantage when designing for earthquake conditions.

It should be possible to restore a boiler to service more rapidly if a tube failure should occur.

The ratio of steam to water passing through the drum separators is greater because only about one third as much water is circulated.

Because oil is expected to be the major fuel, turbine bleed steam will be supplied to the coils of steam-air heaters between the forced-draft fans and the main regenerative air heaters to minimize deposits and corrosion on the cold end. This will be done the year round, even in the summer months. The air entering the regenerative air heaters will be heated to maintain the air-inlet end of the revolving elements at an average metal temperature of 215 F.

Experience with many oil-burning installations has shown a need for frequent removal of deposits from cold-end air-heater surfaces. Etiwanda will be one of the few installations designed to permit water-washing such surfaces without taking the boiler out of service. Air soot blowers will be provided but, should these be unable to remove the expected deposits, washing will be done under load thereby saving fuel by maintaining boiler efficiency and improving availability at small investment cost.

COOLING TOWER

To adhere to the ideal of a simple, rugged, and economical installation, a cooling tower common to both units was carefully planned to minimize first cost and simplify maintenance. Fig. 6 shows the unusual foundation design comprising a plain flat slab, omitting even pedestals for column bases. This construction avoids the usual basin and its cleaning difficulties. Seldom is it realized that a cooling tower for an installation like Etiwanda must handle 4000 cu ft of air for each kilowatt-

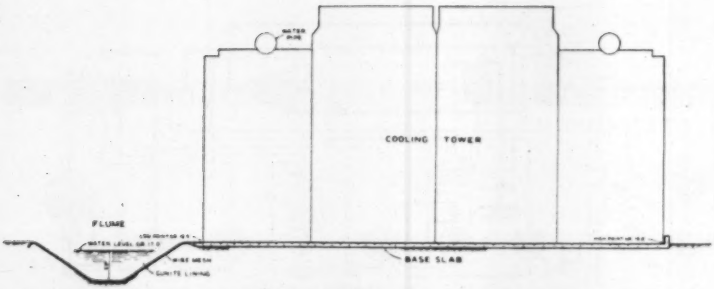

FIG. 6 A PLAIN FLAT SLAB SUPPORTS THE COOLING TOWER AND AN 850-FT GUNITED OPEN FLUME ACTS AS THE WATER BASIN

(The flat slab may be hosed down easily, and a central settling chamber in the flume accumulates debris from the four cooling-tower sections.)

hour, or a 250-ft cube of air per minute for full load of 250 mw. As the district where the plant is located is subject to unusually continuous winds of varying intensity, provision is being made to handle the dust, leaves, tree bark, and insects that may, at times, be collected in the cooling-tower system. With the flat-slab base, such debris can easily be hosed into the open gunited discharge flume and removed at the central settling chamber in the flume. Further, less distance between the bottom cooling-tower fill and the slab will make maintenance more convenient than with the usual deep basin.

The possibility of exploiting the favorable wind condition to the maximum by the most advantageous tower orientation was investigated, i.e. parallel or normal to the prevailing wind. However, few data are available on the isotherms to be expected on the lee side of cooling towers in any particular position. Particularly are data unavailable on recirculation as affected by tower orientation. Other major considerations were avoidance of recirculating vapor to future towers and minimizing drip or fog effect on plant working areas. These studies led to positioning four 145-ft-long sections of tower nearly normal to the prevailing wind direction with 85 ft between sections. This layout should give optimum performance for the 835-ft length.

The cooling-tower make-up problem was accentuated by the necessity of using Colorado River water having about 700 ppm of dissolved solids. Also, this is expensive water, as it must be raised by pumps a total of 1618 ft and transported more than 250 miles from Parker Dam across the intervening desert before reaching the plant.

A treatment plant will stabilize the cooling-tower make-up water, relatively high in dissolved solids, to allow higher concentration and hence minimize blowdown. This result will be accomplished by maintaining a suitable Langelier saturation index to avoid deposition of scale on condenser, hydrogen, and oil-cooler tubes, on one hand, and avoid the corrosion attendant on excessive acidity on the other.

Special attention is being given to means of handling fan parts during maintenance and overhaul to keep down the size of maintenance crews. A 1-ton gantry crane made from piping and built to travel along the tower top will lift and transport motors, gearboxes, or fan blades to one end of each tower section where they may be lowered to the ground through a trap door.

Where possible, open gunited flumes are being used for conveying the 140,000 gpm of circulating water, that type of conduit being considerably more economical than the 8- and 9-ft-ID precast concrete pipe being used elsewhere.

To provide cooling-water make-up for a few days should the aqueduct water supply be interrupted, a 40-acre-ft (13,000,000 gal) storage basin is being built on the site. This basin is formed of rolled earth-fill dikes constructed by the modern earth-dam techniques. A gunite lining will be provided to avoid loss of water and the risk of damage to the basin by rodents and erosion.

CONDENSING SYSTEM

Among the unusual features of the condensing system will be the use of a large-capacity reciprocating dry-vacuum pump as a "hogging" jet for evacuating the steam spaces rapidly, as well as to back up the single set of steam-air ejectors and allow starting the turbine-generator at about 100 psi steam pressure.

A rubber expansion joint between turbine and condenser is being provided to avoid throwing any heavy earthquake load on the turbine.

FEEDWATER SYSTEM

Deaerators are usually placed at a 50- or 60-psia bleed point to avoid vacuum operation, but, as stated elsewhere, the Etiwanda deaerator will operate at a 15 psia pressure at turbine loads of 80 per cent capacity and over and will be provided with equipment for automatic removal of noncondensable gases during partial-load operation.

As shown in Fig. 5, the heaters on the two high-pressure bleed points are in two streams because four smaller heaters proved less expensive than two large ones. It also was possible to eliminate heater by-passes as all the condensate can be passed through either stream; hence there is less effect on station capacity when removal of a heater from service is necessary, there being less lowering of feed temperature and disturbance of boiler temperatures.

Boiler make-up will be obtained from wells on the site. This water will be pretreated to reduce hardness and alkalinity before sending it to the evaporators.

Two 100,000-gal tanks will provide condensate storage.

PIPING

The gate valve between boiler and steam turbine was omitted to save the first cost of $36,000 for two units and because valves are often a cause of outage.

The design of the main steam leads started with the ideal objective of having two equal straight runs arranged like an "L," one downward from the superheater outlet, and one continuing horizontally to the turbine. As the design of the plant

developed, a few compromises were necessary in the layout to avoid interference with large steel members, particularly earthquake bracing and gusset plates, to change which would have cost far more than modifying the piping.

Careful comparisons were made of the cost of providing flexibility in the main steam leads themselves as against rigid piping with a flexible superheater-outlet header, which would cost $25,000 per boiler. Designing the steam leads with more flexibility proved cheaper. However, this was not the case with the 16-in-OD 1-in-wall hot reheat piping having some 8.7 in. expansion per 100 ft, in which case it proved far more economical to use a flexible or movable outlet header which would follow the vertical movements of the piping. On the other hand, providing inherent flexibility in the cold reheat piping proved more economical than building a movable cold reheat header.

To attain simplicity, the policy of creating as few interconnections as possible was followed; operating experience having shown that they often cause as much outage time as they save, if not more. There will be no steam or feedwater interconnections between units. Further, to reduce piping, insulation, and valve costs, the use of auxiliary steam has been reduced to a minimum, it being used only for oil heating and normal air ejection. Soot blowing will be performed by air stored at 500 psi and supplied at 350 psi.

Other means used to reduce investment in piping are as follows:

Elimination of many pipe trenches by backfilling trenches containing bare steel pipe with oil-saturated soil.

Two fire systems, one at the station served by two pumps backed up by the service water system, and the other at the oil tanks and cooling towers proved more economical than a single system because the tanks and towers will be remote from the rest of the station. Safety and reliability also were improved because the equipment is more dependable than the long interconnecting piping.

Normally, two steam-supply lines would be used for fuel-oil tank heaters, but only one is being constructed with provision, in case of emergency, for use of the condensate return line for steam supply, temporarily wasting condensate during such infrequent use.

Inasmuch as the height of the turbine deck for this station was reduced to the minimum because of seismic forces, less than a 24-ft-high space is available for piping and auxiliary equipment beneath the turbine deck. To provide an economical and orderly piping arrangement, the layer system of piping was used with all main north-south runs at one grade and east-west runs at a different grade.

INSTRUMENTATION AND CONTROL

The centralized control room is being built between the boilers at the same level as the main-turbine operating deck. The control boards have been kept to minimum length to simplify actual operation and for operator convenience while restoring service after an emergency trip-out. Ample time is almost always available to start a unit from cold, but this is not so when restoring service after a trip-out. To this end, only those instruments actually required for controlling the turbine, boiler, and auxiliary equipment are on the front of the board, while recorders, supplying historical data primarily for result purposes, are placed on the back of the boards. Fig. 7 shows the compact control room, the boiler-turbine boards being only 17 ft 3 in. long for each unit.

Pressure and flow measurements will be telemetered electrically or pneumatically to the control room from local transmitters so that only low-pressure lines will be brought into the control room, thereby minimizing the hazards to operators and equipment.

If the turbine stop valves close simultaneously, relays will automatically decrease fuel supply 80 per cent in order to prevent the reheater from overheating as well as to maintain fires for an immediate restart without delay for lighting off. Upon closure of both stop valves, relays also will automatically open the main generator breakers after a 5-min delay.

The combustion system is designed to control oil and gas separately, or in combination, with automatic adjustment of either as "swing" or "base" fuels.

In the interest of reliability and availability, two flame "Utiliscopes" are being provided per boiler, one for each half-furnace, so that the condition of all portions of the eight flames as well as the ignition torches in each half-furnace can be seen in the control room. Initially, this seemed a difficult task to accomplish because the single previous installation of such equipment had used a roof-camera setting, but such a setting

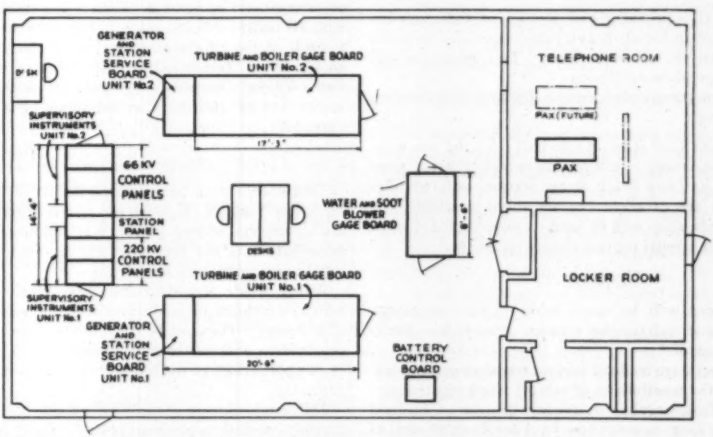

FIG. 7 ETIWANDA CONTROL-ROOM LAYOUT SHOWING COMPACT TURBINE-BOILER ELECTRICAL CONTROL BOARD

for the Etiwanda boilers would have caused a most difficult cooling problem as the Utiliscopes would have been in a deep hole between the boiler roof and the upper furnace tubes. This problem was solved by using "bay windows" formed by simply bending tubes inward in the upper front wall.

Although automatic starting of essential spare pumps has been provided, direct control of important pumps is being provided to the control-room operator.

Valve control generally has been centralized in four areas of the plant rather than being scattered. All valves for feed pumps, extraction steam lines, and heater drainage piping will be grouped on a mezzanine grade beneath each turbine. Valves for fuel gas, fuel oil, boiler drains, and boiler feedwater control also are on the same mezzanine grade, alongside each boiler. Valves for fuel-oil heating and condensate returns for the fuel-oil heaters are at a third location beyond the draft equipment at ground grade, and control for fuel-oil pumping is provided at a fuel-oil pumping station centrally located between the four 130,000-bbl fuel-oil tanks.

All valves are being so located that they may be operated, packed, or serviced without the use of ladders, scaffolds, or auxiliary platforms, and none will require extension stems or chain wheels. A few valves will have floor stands.

MAINTENANCE

Currently, much emphasis is being placed on reducing the number of plant operators to the minimum, and one frequently hears that a particular plant has only about six operators per shift, without mention of the men required on maintenance. In the modern plant, the maintenance crew is usually appreciably larger than the operating crew. Although Etiwanda will meet the optimum criterion with only six operators for two 125-mw units, close attention has been given to minimizing the maintenance organization by simplifying its work, such as by providing:

Well-pitched floors and adequate drains so that all unenclosed concrete floors may be hosed down without the need for sweeping or using vacuum cleaners.

Portable gantrys for handling cooling-tower parts and light turbine parts during maintenance or overhaul.

Davits for handling heater parts.

Hoists for handling circulating-water screens and certain outdoor pumps.

Space around all equipment and motors so that fork-lift trucks may be used to handle heavy parts, especially those on ground grade and on concrete floors. This provision has minimized expensive monorail hoists.

Galvanized open-grating platforms to eliminate floor cleaning and future painting.

A simple machine shop is being provided with the minimum number of machine tools. Because the company has a good machine shop at its Long Beach Steam Station, only 50 miles away, and there are excellent custom shops available, the minimum Etiwanda shop will be used as now provided until justification for additional tools is clearly established.

ELECTRICAL

Generator output will be raised from 15.5-kv to 220-kv system transmission voltage by separate transformer banks serving each generator.

Economic studies were made of various transformer combinations, that is, of the possibilities of using 3-phase transformers and of various basic insulation levels. Because of railroad clearances for the long cross-country haul involved, as well as first-cost disadvantage, 3-phase transformers proved uneconomical for the ratings involved. The company previously has used 1050 kv as a basic insulation level for all recent 220-kv transformers on its system, but studies for Etiwanda showed about $170,000 saving by using an 825-kv basic insulation level and providing arresters.

Study also was given to the use of isolated-phase generator lead construction, but this proved uneconomical for all except the runs below the turbine deck. Elsewhere, the runs will be aluminum channel on post-type insulators, protected by gratings above and screens below. The resultant saving is in the order of $70,000.

As shown by the system diagram, Fig. 3, the main transmission to the system will be by a 220-kv line, each, to Highgrove and Barre substation. Space is being provided for a 66-kv outlet when needed to serve local requirements.

UNUSUAL PROBLEMS

Because the water from the cooling towers will have a concentration of about 3000 ppm, it will not be wasted to stream channels in order to avoid possible percolation into the groundwater basin. A waste-disposal system will be built in conjunction with the established disposal agencies in Los Angeles County to convey all industrial waste approximately 50 miles to the ocean. This disposal will require construction by the company of a 15-mile concrete pipe line of 5 cfs capacity to connect with existing trunk sewers in which capacity will be purchased.

Three means of transporting fuel oil to the station were studied, including pipe line, truck, and rail. Because of the large savings available, an $8^{5}/_{8}$-in-OD pipe line will be built about 40 miles across country from Santa Fe Springs to Etiwanda with three heater pumping stations to divide the line approximately into thirds. Initial temperatures of 200 F will be necessary to avoid excessive pressures during winter conditions. Electrically driven reciprocating pumps will provide 800 psi pressure for flows of from 400 to 700 bbl per hr. Heating will be by means of direct-fired tubular heaters of the type common in the oil industry.

ACKNOWLEDGMENT

Acknowledgment is gratefully made to Mr. John Bruce and other operators who participated in the design discussions, to Mr. T. M. Hotchkiss and other engineers of Southern California Edison Company, and to Mr. W. C. Woodman and other engineers of Stone & Webster Engineering Corporation, who all realize that no plant is the work of one person, but a result of the efforts of many. It is believed that the Etiwanda Steam Station will mirror the desire of Southern California Edison Company to provide steam-produced electrical energy to its customers at minimum cost and maximum availability.

THE establishment of the Walter Kidde Nuclear Laboratories, Inc., New York, N. Y., with the primary objective of developing commercial atomic power, was announced recently. The organization is the first privately financed laboratory dedicated to research in nuclear power.

Walter Kidde Nuclear Laboratories, Inc., will perform research, development, and experimentation in the field of nuclear energy. The services of the firm will be available to other organizations interested in the design of nuclear power plants or in applications of nuclear technology to their products and processes.

THE establishment of the Walter Kidde Nuclear Laboratories conforms with the announced policy of the U. S. Atomic Energy Commission which encourages participation of private capital in atomic development.

ORGANIZING COST REDUCTION

By TOM C. GARY

ADMINISTRATIVE ASSISTANT, ENGINEERING DEPARTMENT, E. I. du PONT de NEMOURS & COMPANY, WILMINGTON, DEL.

As the eighteenth century came to an end, Eli Whitney certainly established the position of American engineers in the mechanical industries for cost reduction. Eli was graduated from Yale in 1792 when he was 27. A year later he invented the cotton gin to reduce the cost gap between agriculture and the textile industry. Some 130 years later, discoveries by Carothers in the laboratories of the author's company led to the first synthetic textile fiber—a product of the chemical industry.

Disgusted with the struggle over infringement of his patent, Whitney turned to the mechanical industry when he began the manufacture of firearms. He introduced in his factory the division of labor and the standardization of parts. The division of labor and the substitution of power for human slaves, coupled with the ingenuity of thousands of engineers at work in an atmosphere of individual freedom is now accepted by the world as the very foundation of mass production in America. With much credit to the perseverance of the American Standards Association, standardization is now recognized as one of the most lucrative fields in organizing cost reduction. I do not stress availability of our natural resources because such natural resources were present in abundance in Russia, though little used, centuries before Columbus discovered America.

Before I describe how the du Pont Engineering Department organized cost reduction, a thumb-nail history of the company itself and of its Engineering Department is important. A better understanding can be gained of the fact that much of what we are doing in the chemical industry can be adapted, with little modification, to organized cost reduction in the mechanical industries.

EARLY DAYS OF CHEMISTRY IN AMERICA

Although Lavoisier, who died under the guillotine in 1794, during the French Revolution, is called the father of modern chemistry, the United States did not have a chemical industry worthy of the name until the time of the first world war.

Eleuthere Irenee du Pont de Nemours, who in 1802, founded the company which bears his name, had been a pupil of Lavoisier. The young French refugee was more than a chemist; he was also a first-rate engineer. This was naturally so, as black powder, the first du Pont product, involved mechanical mixing of ingredients rather than chemical reactions. A patent on a "Machine for Granulating Gunpowder" issued to him in 1804—only 2 years after he had built his first mill—attests his inquiring turn of mind and his desire for improving methods of manufacture. Young du Pont was knocking at the door of the Patent Office only 8 years after Eli Whitney. In little more than a year after breaking ground for his mill on the Brandywine and with pitifully small capital of $36,000 provided by a French syndicate, he was producing powder and had also built, near the mills, a sizable house for his family, of such permanence it is now occupied by a descendant. I have seen authentic records of the founder and can assure you that our cost-reduction program, though not organized until many years later, actually began in 1802.

Presented at the Production Engineering Division Luncheon in conjunction with the Annual Meeting, Atlantic City, N. J., November 25–30, 1951, of The American Society of Mechanical Engineers.

After 150 years, du Pont now manufactures thousands of different products which it sells to many more thousands of different customers. It has 8 per cent of the chemicals and allied products business in the United States and has about 10,400 competitors. Only about 8 per cent of these products reach the ultimate consumer bearing the du Pont trade-mark. The remaining 92 per cent are used by others in the manufacture of a wide variety of products. In 1950, more than 60 per cent of du Pont sales were of products that were unknown or in their commercial infancy 20 years before.

COST REDUCTION IN CHEMICAL AND MECHANICAL INDUSTRIES SIMILAR

The chemical industry, in which complex chemical synthesis is now commonplace, uses in the building and operation of chemical manufacturing plants, as young du Pont did in 1802, most of the known engineering techniques which are used in the mechanical industries.

So, as I explain how the du Pont engineering department organized cost reduction, the reader may find much in common between the chemical and mechanical industries. One important difference should be kept in mind. Most of the products of the chemical industry begin in glass laboratory equipment—in the test tube. Most of the products of the mechanical industry begin on the drawing board.

For 100 years our production people were responsible for all engineering, including the design and building of new plants and equipment—often directed by a descendant of the founder. Our engineering department, established nearly 50 years ago, now supplies all kinds of engineering services to all other departments, and is mostly concerned with the following:

1 Design and construction of the manufacturing plants—the equipment, the buildings, the utilities, and all service facilities.

2 Assisting the manufacturing departments with equipment and materials improvement and cost reduction.

3 Conduct of all phases of engineering research and development applicable to our business.

HOW AN ENGINEERING DEPARTMENT IS ORGANIZED

The organization of our engineering department is functional and the department is composed of four operating divisions. The design and construction divisions design and construct all facilities. The construction division has, in Wilmington, a foundry capable of making iron castings up to 30,000 lb, bronze up to 3000 lb, and aluminum up to 1000 lb, and a machine shop completely equipped for precision work on both large and small special equipment and machines. We manufacture only for our use equipment and machines of special design, not commercially available.

The engineering service division assists the manufacturing departments through consultation and assistance to the plants on engineering problems concerned with equipment and materials improvement and cost reduction. This division has a similar function to that of the production engineers in the mechanical industries. The service engineers are about equally divided between field engineers, resident at many manufacturing plants varying from one engineer to a group of ten or more engineers,

and a large group of consultants with headquarters in Wilmington but spending much of their time at the plants. They specialize in many fields, such as steam and electric power, water—which is of great importance in the chemical industry both as to quantity and quality—chemical engineering, materials of construction, mechanical transmission and lubrication, materials handling and packaging, plant maintenance, and management engineering. The field engineers also assist the design division in gathering basic data and making field tests, and the consultants assist on problems within their fields of specialization.

The development engineering division is responsible for engineering research and development and has two well-staffed and equipped laboratories located in Wilmington. The engineering research laboratory is equipped for (1) experimental chemical engineering for superpressures—much higher than the 5000 to 10,000 psi often encountered in commercial plants—fluid flow, heat transfer, distillation, filtering, grinding to 1 or 2 microns, and fine-particle collection; (2) work on materials of construction, both ferrous and nonferrous, a field of great importance because of the corrosive nature of many of the liquids and gases encountered in chemical processes; and (3) work in applied physics for the automatic control of complex chemical processes, and instrumental inspection of products such as yarns and filaments of 1 mil diam, which must be controlled within plus or minus 5 to 10 per cent at speeds of hundreds of yards per minute, and comparable control of films.

The mechanical development laboratory is equipped for research on mechanisms and such machine elements as superspeed spindles and precision cams, so important in the manufacture of synthetic fibers, and supersurface finishes needed for the manufacture of photographic and other films. It also engages in the development, fabrication and testing of prototype commercial-scale automatic precision machines such as those used in the manufacture of synthetic textile fibers, electric blasting caps, and photographic film, and other special machines, including many for the manufacture of sports arms and ammunition by our affiliate, the Remington Arms Company.

In these laboratories we seek new knowledge needed in the design today of chemical plants which are less likely to become obsolete tomorrow.

Many of the uninformed puzzle over why we need such a completely integrated engineering department—we can count more than 100 types of engineers on our staff, including two meteorologists—and why we do most of du Pont's engineering and construction. We do it because we have found from many years of experience the continuing partnership between research, engineering, and production promotes the fullest use of technological improvements in engineering to reduce construction cost. It also brings new products more rapidly into commercial production and helps keep operations constantly up to date in a highly competitive and fast-growing industry. But we do not consider ourselves to be self-sufficient. Not only when confronted with an abnormal volume of urgent work but in what, by comparison, we might call normal times, we do not hesitate to engage the special talents and skills of independent engineering concerns and builders to help us obtain the best and most economical job for the purpose.

Our design division now enjoys the assistance of several large and small engineering concerns. Our construction division builds with its own forces only those parts which it can best do for the over-all benefit of each job as to time, quality of work, and cost. Our Wilmington shops look to others for many machine components. We have a staff of six university consultants, nationally recognized in their fields, who regularly give us a part of their time.

In 1920, soon after Herbert Hoover was elected the first President of the Federated American Engineering Societies, he suggested a study be made, aimed at the restrictions and wastes in industry. Report of this study, called "Wastes in Industry," was published as a book in 1921. It is with head bowed in shame for industry, and more particularly, for the engineering profession, that I advance the suspicion that the most use made of this provocative book was to gather dust on library shelves. Although the Federation expired, renewed efforts for joint action have been made, first by the Engineers Council for Professional Development beginning in 1932, and later by the Engineers Joint Council in 1941—one of the activities of these organizations is aimed at the elimination of professional manpower waste. Thirty years later, Mr. Hoover headed a study by the Commission on Organization of the Executive Branch of the Government.

Let us hope the proposals of the Commission will receive more favorable action by the Government than did the former Hoover study by industry.

HOW DU PONT DIVISIONS TACKLE COST REDUCTION

What we now call our engineering service division had its beginning 18 years prior to the first Hoover study and was our first effort for organized cost reduction. It continued to spearhead cost-reduction work until about 5 years ago when all divisions of our engineering department were organized for cost reduction. In the design division most cost reductions are obtained through improved design, standardization, and substitute materials, and by assisting the research and manufacturing departments by engineering and economic evaluation of processes to simplify equipment and select the least costly of several alternatives which will meet the capacity and quality requirements.

Engineering standards are an important source of cost reductions. We use most of the accepted national standards, supplementing them by du Pont standards developed and adopted to serve our special needs. The standards are developed by 23 part-time subcommittees, averaging six members each, assisted by a large group of standards engineers devoting full time to the work. A recent example of cost reduction was the saving of 1000 man-days in the design of a large steam-electric generating station through the use of 450 du Pont standards.

The construction division obtains cost reduction mostly by careful planning and scheduling of the sequence of relatively small elements of work and by the unremitting search for the best tools and methods for the effective use of field labor. It reviews all plans and specifications during preparation, and continues the review as construction proceeds, for modification in design and materials to facilitate construction and lower cost.

During the past several years, we have adapted and applied to construction operations the work-simplification and work-measurement methods used by many concerns in repetitive production work. It is generally accepted that 85 per cent of the labor for building a plant is devoted to the handling of, and only 15 per cent to working on, the materials. Is it realized that shortening by 50 ft the distance which materials must be carried to be put into position will reduce the handling cost about $175 per year for each man on the job? Such improvements in method are brought about by planned work. We now schedule 95 per cent of all construction work and cover 78 per cent of the work by detailed written plans and craft measurement. We currently obtain 84 per cent performance as compared with our standards. So far as we know, we are the first to even attempt application of the principles and methods of industrial engineering to construction. Each day offers another opportunity to the industrial engineer to improve pro-

ductivity and manufacturing cost, but there is only one opportunity to build a manufacturing plant economically.

The engineering service division, since its beginning many years ago, continues cost reduction as its primary function and is ever deepening and broadening its field to keep pace with new techniques and the diversification and growth of the business of the company. Years ago, some skeptics asked when we might reach the level of diminishing returns. With the recent astronomical increase in cost of raw materials, wage rates, and corporate taxes, the skeptics have vanished from the scene.

The development engineering division has as its main objective the minimizing of plant investment—a worth-while objective when in the past 10 years construction costs have doubled. The members of this division, whose accomplishments are usually reflected a year or two later in the work of the design and construction divisions, do not neglect cost reductions applicable to their own work. For example, the engineering research laboratory recently devised a new heat-treatment test applicable to most of the materials we use. Stainless steel, which we use in large tonnage, is now tested with assurance in 15 min compared with 240 hr for the previous conventional method. In addition to the appreciable reduction in cost of acceptance tests, the 10-day hold-up time is eliminated, a quick and simple test is available to the field for "on-the-spot" testing of heat-treatment, and a simplified low-cost test for judging the condition of laboratory specimens will contribute much toward accelerating research.

PRINCIPLES OF COST REDUCTION

Probably many readers have become impatient to learn what we consider the prerequisites for organizing cost reduction effectively.

There are five prerequisites, as follows:

1 Recognition by management of the need for and realization, in terms of dollars and cents, of the tremendous advantages to be derived from organized cost reduction, and the continuous support and stimulation by management of the program.

2 Indoctrination of the organization at all levels as to the objective and means of accomplishment. Ultimate results will be obtained only when each individual has established a one-man organization for cost reduction. We know from experience that a carefully administered Employee Suggestion Plan, with rewards commensurate with the value of the suggestions, is surprisingly effective in this indoctrination. The dollar-value proportion of cost reductions derived from the plan is small compared with the interest in cost reduction the plan arouses throughout all levels of the organization.

3 Line organization must be held responsible for accomplishment. Supervisors at all levels must meet periodically with the workers to review accomplishments and plan ways and means to meet the goals.

4 One or more engineers in each division, well trained in the principles and methods of cost reduction, must devote full time to training and assisting the line organization in carrying out the objective of management. This is not a routine job—it is a challenge for one or more of the most enthusiastic, level-headed young engineers in the organization.

5 A realistic goal must be established before the beginning of each year for each part of the organization. Reasonably accurate and descriptive periodical reports of accomplishments must be prepared, preferably after each quarter ends, and a summary after each year ends. The reports should be audited by an experienced engineer who is imbued with intellectual honesty and will be tolerant but firm in determining the admissibility, eliminating the fictitious, and checking the evaluation of all items, on the basis of established ground rules. For a sizable organization—let's say of 500 or more people—management and top supervision could profitably devote an entire day at the end of each reporting period to a critical review of the accomplishments and exchange of new ideas to enhance the effectiveness and growth of the program.

SUMMARY OF COST REDUCTIONS

The form we use for summarizing the financial accomplishments of each division, by categories, is given herewith.

For the past year the summaries for each division including, for the construction division, accomplishments at 34 construction locations scattered over a large area of the United States, will be combined for the department report. It will include goals for next year, based on the budgets and forecast of work to be done in that year. Dollar accomplishments are omitted because if I showed them for 1950, the fifth year in which all divisions were organized for cost reduction, many might believe the figures were fictitious. I will state that cost reductions in the 5 years totaled millions of dollars and in 1950 exceeded goals by 63 per cent. Cost reductions in the permanent plant-investment categories were the equivalent of about 12 per cent of the construction expenditures in the corresponding year.

Some may question combining operating cost and permanent investment reductions. As unorthodox as this may seem, the grand total is the final measure of the accomplishments. The dollars it represents in the cash box are the same regardless of their source. Although we report operating cost reductions for one year only, many of them continue in effect for succeeding years.

The financial summary is supplemented by a brief explanation and amount of cost reduction of each item of $1000 or more. Items less than $1000 each may be combined for inclusion in the category total but must not exceed 10 per cent of that category amount.

The ground rules are as follows:

Category 1: Show reductions actually obtained in the reporting period. State reduced number of employees, occupation, and reason; i.e., change in organization or function. Omit reductions resulting from change in forecast volume of work.

Category 2: Each division is credited with space reduction through improved utilization, but shown in departmental summary only when a net reduction for the department is effected and the space is released to the office buildings department.

Category 3: Travel, telephone, and office supplies reductions.

Category 4: Generally result in man-hour reductions, none of sufficient magnitude in themselves, but combined, result in decreased personnel or avoid increasing personnel. Construction-field, shows such reduction in categories 8, 9, and 10.

Categories 5 to 11: State project number, plant location, and product. Evaluate reductions against former practice or the average performance for the previous year. Category 6 is reduction in planned new facilities through unusual proposals accepted by the industrial departments. Omit write off of obsolete facilities and show effect of depreciation on operating cost under category 3 or 13.

Category 12: Usually reduced fuel, raw materials, or stores inventories.

Category 13: Mostly work of the engineering service division field engineers and consultants assisting plants of the industrial departments in improving equipment and material and labor utilization.

Categories 14 and 15: Unusual schemes for expediting authori-

1951 COST REDUCTION PROGRAM—JANUARY TO DECEMBER, INCLUSIVE
DIVISION OF ENGINEERING DEPARTMENT

Cat. No.		1951 goal	Reductions Jan-June, incl.	Reductions July-Dec., incl.	July-Dec., per cent of goal (based on ½-yr goal)	Reductions 12-mo period	Jan-Dec. per cent of 12-mo goal	1952 goal
	Operating-cost reductions in engineering department reflected in cost sheets:							
1	Salaries and wages, including related expenses							
2	Office rental							
3	Other expense							
	Subtotal							
4	Operating-cost reductions in engineering department not reflected in cost sheets							
	Plant-investment reductions:							
5	Reduced facilities							
6	Substitute materials							
7	Improved design							
8	Improved methods							
9	Improved procedures							
10	Personnel effectiveness							
11	Material cost							
	Subtotal							
12	Working-capital reductions							
13	Operating-cost reductions in other departments							
	Intangible reductions:							
14	Earlier authorizations							
15	Earlier start-ups							
16	Operating cost in other departments							
	Subtotal							
	Grand total							

zation and start-up of new manufacturing facilities not appropriate under categories 5 to 11.

Category 16: Usually effected in the design and construction stage of new facilities, hence not reflected in manufacturing cost sheets as in category 13. Omit reductions in fixed charges for items reported in categories 5 to 11.

General: Reductions are reported only when they can be substantiated under the rules and the dollar value calculated. Continuing cost reductions in categories 1, 2, 3, 4, 8, 9, and 10, effected in the period are reported and continued in the next period to a total of 12 months—after which the change is incorporated in engineering standards and procedures or accepted as the normal method or procedure. In category 13, show continuing reductions in the period placed in effect in the amount to be effected in a period of 12 months. Reductions in categories 12, 13, 14, 15, and 16 are calculated according to company practice in calculating return on tangible permanent investment and working capital. Categories 12 and 13 apply only to existing facilities.

Some may gain the impression the operation of our cost-reduction program requires an elaborate organization and an enormous amount of paper work. No change and a minimum of interpretation of the rules has been found necessary during 5 years of operation of the program. The year-end report for 1950, totaling millions of dollars made up of items ranging from $50 to $500,000 each, including a brief description of all items exceeding $1000, consisted of only 96 letter-size pages.

In the beginning, we reported quarterly and summarized accomplishments for the full year. We now report at mid-year and for the full year.

Good or bad, the news will be quickly communicated down the line to all members of the department. So far, since all divisions have been organized for cost reduction, the news has been good! Very good!

SMALL CONCERNS CAN GAIN FROM COST-REDUCTION PROGRAM

Should any reader have formed an opinion that most of what we do may be applicable only in the du Pont Company—and a few may even doubt that it is actually done there—let me offer a word of encouragement. Some individuals may work for relatively small concerns. We enjoy the assistance of thousands of small concerns, both vendors and subcontractors, in performing engineering work for du Pont. More thousands of concerns, some large but the majority of them small, are assisting us in the design and construction of the Savannah River Plant for the Atomic Energy Commission. We know from long association with many of them that no matter what size each may be, what we are doing they also can do. Cost reduction is not easy.

The small concern, having the advantage of easier communication and control, should be able to accomplish a cost reduction of $100,000 more easily than a large concern can accomplish a cost reduction of a million dollars.

There is much waste in government and in industry which can be eliminated through organized cost reduction. Speaking at Chicago in October on the subject of "What Kind of Incentives?," Mr. C. H. Greenewalt, the president of our company, said: "I doubt that there is much to be gained by berating the administration or our representatives in Washington for federal spending and governmental extravagance. Those in public office after all reflect what they consider the wishes of their constituents to be. For that we cannot blame them. They

(Continued on page 588)

THE ASME BOILER CODE

I Introduction—The Antecedents of the Code

By ARTHUR M. GREENE, JR.

PRINCETON UNIVERSITY, PRINCETON, N. J. HONORARY MEMBER ASME

THE ASME Boiler Code was developed not only primarily as a safety measure but also to furnish standards by which any State could be assured of the suitability of boilers for installation within its borders. It arose "in the fullness of time," from the rules, regulations, or laws that had been set up in the fifty or more years before its first publication in 1914 and particularly from the Boiler Rules of the Commonwealth of Massachusetts of 1909. For many years before this time there had been rules for the construction of marine steam boilers issued by underwriters, such as the Lloyd's Registry Rules and those of Bureau Veritas, or by governments, such as the British Board of Trade Rules and those of the Steamboat Inspection Service of the United States. For stationary boilers, boiler insurance companies had issued tables showing the proper proportions of elements of boilers which gave results of tests; and a few states and cities had passed laws relating to some details of boiler inspection and equipment and the licensing of engineers, firemen, and boiler inspectors. In addition, during this early period a number of excellent engineering textbooks were available which contained theoretical design methods and practical procedures for safe boiler construction.

STEAM-USING DEVICES PRIOR TO 1800

Devices using steam were known in ancient and medieval times as shown in the writings of Hero of Alexandria, della Porta, de Caus, and Branca. The boilers for these devices were capped caldrons, spheres, or shaped castings, but no records of their performance are known. In 1663 Edward Somerset produced a pump using steam from a boiler which is described in accounts of the period, and evidence of its existence is to be found in some grooves in the walls of Raglan Castle which contained parts of this device. Somerset's method of employing steam was also used, probably independently, by Thomas Savery in his patent of July 25, 1698, and in 1699 a working model of it was exhibited before the King and the Royal Society of London. The boiler used by Savery was cylindrical with dished heads. Steam from the boiler was discharged on top of water in a vessel and forced it into a vertical pipe leading to a delivery point at a higher elevation. This primitive pumping device was the first practical steam engine and it was applied usefully in a number of mines. The boiler was equipped with try cocks at the tops of vertical pipes of different lengths leading into the shell. The lever safety valve, applied by Denys Papin for the control of steam pressure on a digester in the eighth decade of the seventeenth century, was not used by Savery although later designers of the Savery engine, Desagulier, for example, used such a device. Probably the first recorded boiler explosion was caused by an operator hanging a heavy weight on the end of the valve lever to make the pump work faster, which resulted in the rupture of the boiler and the death of the operator. In this machine the steam pressure was fixed by the pumping head. Ruptures or explosions occurred when the temperature of the steam at the required head melted the common solder used in the boiler seams. At a later date spelter was substituted for solder.

The steam engine of the blacksmith Thomas Newcomen and his assistant John Calley of 1705 employed a piston in a cylinder as earlier suggested by Huygens, and also Papin, for their gunpowder engines. In the Newcomen engine, steam at about atmospheric pressure was introduced beneath a piston as it was retracted in the cylinder by counterweights, in the form of a pump plunger, attached to the opposite end of an oscillating or walking beam. At the end of this stroke condensation of the steam below the piston, caused by the admission of water into the cylinder, permitted the atmospheric pressure on the top of the piston to force it downward, thus raising the pump plunger at the other end of the beam. As the pressure of the atmosphere was the operating force, the engine was known as the atmospheric engine. It required a steam pressure in the boiler not greater than that of the atmosphere, and as a result the boiler could be constructed with little or no bracing. The shape of the early boilers was somewhat similar to that of a haystack with a furnace below and passages around the lower part of the shell leading to the chimney. Smeaton describes a boiler built of masonry cemented with hydraulic mortar and containing three copper flues 22 in. in diameter, one of the earliest, if not the earliest, flue boiler. There are records of some boilers with wooden-box shells containing metal flues for the passage of gases. Other early boilers were made of copper, some of them dome-shaped, with flues. Later, sheet iron was employed, and then cast iron $\frac{1}{4}$ in. thick.

RISE IN PRESSURE BEGINS WITH WATT ENGINE

From a study of a model of the Newcomen engine at the University of Glasgow, James Watt invented his engine with a separate condenser. Following this, pressures were increased and cylindrical or conical forms of boilers were employed with dished heads or of bent forms to withstand internal pressure. In 1800 Oliver Evans, one of America's first engine builders, used a long cylindrical boiler with an internal flue for the return of gases from the lower outer masonry flue leading from the furnace below one end of the shell. Even as early as 1791 Nathan Read of Salem, Mass., patented a vertical tubular boiler made of metal.

One of the first water-tube boilers was invented by Barlow in 1793 and was used by him and Robert Fulton on steamboats. It consisted of a series of tubes around which the products of combustion were circulated to evaporate the water. In 1804 John Stevens built a sectional water-tube boiler with many small tubes in place of fewer large ones of less strength. It was designed for use on steamboats with steam at 50 psi instead of the pressure of 4 or 5 psi common at that time.

In the early part of the nineteenth century steam pressures in boilers were of these low values, although Oliver Evans proposed 150 psi in 1795, and in 1823 Perkins and Martineau re-

Opening chapter of a history of the ASME Boiler Code, prepared for the Boiler Code Committee of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

ceived a United States patent for the use of high-pressure steam. Perkins mentioned pressures as high as 1400 psi using boilers made of cast-iron bars 5 in. square with steam passages $1^1/_2$ in. in diameter at the centers.

BOILER EXPLOSIONS CAUSE FOR CONCERN EARLY IN NINETEENTH CENTURY

As steam pressures were increased above that of the atmosphere and as operators were careless with safety valves and negligent about inspections of the shells and settings (both internally and externally), many ruptures or explosions of boilers were reported in America and in Europe during the first decades of the nineteenth century and caused public concern. In June, 1817, a Joint Committee of the Councils of the City of Philadelphia reported on the subject of steam-boiler explosions on boats and recommended to the legislature of the state a law requiring tests on the strengths of boilers, the use of properly placed safety valves on them, and monthly inspections. In Great Britain also many explosions occurred, especially a very disastrous one in London in 1815, so that in 1817 a committee of the British House of Commons considered the subject and concluded that improper construction or material of a boiler and undue but gradual increases of pressure were the causes of explosions. It recommended that wrought iron be used, that heads of cylindrical boilers be hemispherical or segmental, and that two safety valves be used and set at one third of the test pressure at inspection.

FRANKLIN INSTITUTE APPOINTS A COMMITTEE TO STUDY BOILER EXPLOSIONS

The early numbers of the *Journal of The Franklin Institute* of Pennsylvania, 1826, et seq., contain reports of many boiler explosions on steamboats on the rivers and in factories of the United States, as well as a smaller number of boiler failures abroad. In these reports and in the articles on boiler explosions there are many strange and unproved theories of the causes of such catastrophies, such as the formation and explosion of hydrogen, flashing of water into steam at a higher pressure than that corresponding to the temperature of the water, and flashing into high-pressure steam when foaming water strikes overheated plates on a sudden reduction in steam pressure. These reasons were so different and debatable and the explosions so frequent that on May 13, 1830, the Board of Managers of the Franklin Institute appointed a committee consisting of Messrs. Wm. H. Keating, George Fox, Josiah Lukens, Mathew W. Baldwin, and Samuel Vaughn Merrick to inquire into and report "whether it is expedient for the Board of Managers to institute an investigation into the probable causes of these accidents and the proper remedy to be applied to prevent their recurrence."

On June 10, 1830, the Committee reported that it was advisable to appoint such a committee and that "the application of steam to navigation has been attended with such unforeseen advantages to the world at large, and to our own country, in particular, that no series of accidents in steamboats, however frequent in their recurrence or fatal in their consequence, could probably deter the public from use of them; but if the boats shall continue to run unrestrained by any regulations whatsoever, they must occasion a serious waste of property and, what is more lamentable, a great destruction of life. These accidents ought not by any means to be considered as an unavoidable consequence of steam navigation. They proceed, it is believed in most cases, from defective machinery, improper arrangement or disposition of parts, or finally from carelessness in management. That the causes of accidents may be partially, if not wholly, removed by salutary regulations, appears highly probable; and that there must be a power in the community, lodged somewhere, to protect the people at large against any evil of serious and frequent recurrence, is self-evident. But that such power is to be used with extreme caution, and only where evil is great, and the remedy certain of success, seems equally indisputable."

The Committee pointed out that the determination of regulations was a matter of great importance and for the benefit of the public. It should be carried on by a public body, and could the Congress of the United States find time for this task, the Committee would forbear recommendations. Under present conditions, however, the Committee believed that the Franklin Institute of Pennsylvania was especially able to undertake this work and that the following should be determined: First, "What are the probable causes of the explosions of boilers used on board of steamboats?" Second, "If any, what are the best means to obviate the recurrence of these evils, or to diminish the extent of their injurious influence, if they cannot be wholly guarded against?" Third, "By what means can these remedies be applied and enforced?" This statement of 1830 indicates that the men of that day saw the necessity of an enforceable code.

On the receipt of this report the Board of Managers appointed an investigating committee of seventeen men and they sent out circular letters which stated that in view of the lamentable number of accidents that had occurred on steamboats during the present season and the painful circumstances attending them, the committee asked for reports of explosions containing the following elements:

The boiler: Its size, form and relative thickness, the material . . . (of copper, iron, etc.). If of iron, whether of foreign or American iron, especially in the boilers that exploded.
Safety valve: Its form, size, load in proportion to the thickness of the boiler, liability to get out of order, facility of repair, number used, location.
Supply of water: Mode of insuring a sufficiency, how gaged.
Arrangement of the boilers in the boat: Which is least liable to accident?
Construction of the boat: To avoid the accidents in the boiler.

The letter closed with the statement: "In addition, we will add, that our wish is that the investigation should take the widest range and we beg that you will give the same scope to your answer." It was signed by the seventeen members, all of whom were well known in the public, industrial, scientific, and engineering life and development of Philadelphia and America.

FIRST GOVERNMENT GRANT FOR PRIVATE RESEARCH AND SCOPE OF EXPERIMENTS

The Committee sent out many letters; and as the replies were received, they were published in the *Journal of The Franklin Institute* at intervals and arranged and numbered in order of receipt. During this period (1831) aid was afforded them by a grant of money by the House of Representatives of the United States for the cost of experiments by which to test many of the causes of, and preventives to, the explosions of steam boilers. This, the first government grant for private research, was originally proposed to the Congress by the Secretary of the Treasury of the United States, Hon. S. D. Ingham, a Philadelphian.

Replies Nos. 1 to 13 are published in Vol. 8 (new series) of the *Journal;* Nos. 14 to 28 (part 1) in Vol. 9 (new series); No. 28 (part 2) and 29, in Vol. 10; and No. 30 in Vol. 11 (between July 1832 and July 1833).

The Committee discussed these replies and made investigations of their own, and a subcommittee carried out experiments covering the program arranged after conference with Secretary of the Treasury, Hon. S. D. Ingham.

In the *Journal of The Franklin Institute* from January to May,

1836, is found the first part of the report of experiments made by this Committee:

The object of the experiments was to test the truth or fallacy of the various causes assigned for the explosion of steam boilers, with a view to the remedies either proposed, or which may be consequent upon the results of the investigation. The causes being accurately known, the attention of ingenious men is led away from false suppositions, which can only waste their time and talent, if taken as the basis of their plans for safety; greater hope is afforded of an efficient remedy; the applications of an indirect, or it may be of a positively injurious sort, are avoided; and if the causes be found to be such, as for the present, to baffle ingenuity in their removal, the attention is directed more fixedly toward the means of protection against the effects of such accidents. The committee hopes that the results of their inquiries will not be found without fruit.

It was the aim of the committee to provide for experiment and apparatus of such dimensions as to furnish results applicable to practice, without being so great as to be managed with difficulty, or to increase, unnecessarily, the danger incident to parts of the investigation.

The boiler on which most of the experiments were made was a horizontal cylindrical shell of $^1/_4$-in. rolled iron, 12 in. inside diameter, and 2 ft $10^1/_4$ in. inside length, with flat heads riveted in the usual manner. The setting was of brick, and the fire surface of the shell above the charcoal-burning grate extended around one half of the circumference for the full length of the shell. In each head a glass window was provided, $2^1/_2$ in. × $1^3/_8$ in., for observation of the interior. The setting contained a fire door, ash-pit door, and short chimney at the rear on one side. There were three try cocks, a water glass, a mercurial steam gage, thermometers extending to various depths into the shell, a safety valve, a fusible plate, and methods of feeding water into the steam space and also into the water below its surface near the bottom of the shell from a hand pump of calibrated capacity.

A cylindrical boiler of glass $7^1/_2$ in. diameter and $14^1/_4$ in. long was also used. It was exposed to the fire for its whole length. Two other metal boilers were used for complete explosion.

RESULTS OF FRANKLIN INSTITUTE EXPERIMENTS

Twelve subjects were investigated. The results were as follows:

1 With the glass boiler it was found that when the pressure was that of saturation for the temperature of the water, or greater, the opening of any try cock, or the safety valve, caused ebullition or foaming within the body of water throughout the whole boiler. Through the glass window of the metal test boiler the same effect was noticed. The steam gage always fell on making an opening by cock, safety valve, or fusible plate; but on closing the opening the water settled down and became quite transparent. The try cocks and glass water gage were equally reliable as indicators except with foaming, when the glass did not show the true level. Some alarm floats were tried. These tests also showed that even when the foaming water was forced against the overheated shell there was no increase in pressure.

2 and 6 A repetition of the experiments of Klaproth on the conversion of water into steam by highly heated metal was made by discharging small quantities of water by means of hand pumps against the shell when heated to redness. This resulted in a sudden and positively great increase in pressure and in some cases the formation of superheated steam. Determination was made of the temperatures of hot metal at which the maximum amount of evaporation took place.

3 The projection of water into superheated steam did not produce steam at a pressure higher than that corresponding to the temperature of the water in the boiler, and in the tests the actual pressure decreased.

4 Superheated steam produced by contact with heated metal in the steam space did not evaporate part of the water in the shell to increase the pressure although some tests were extended for two hours.

5 The examination of fusible plugs showed that the composition of these devices did not always fix the temperature of melting and the corresponding pressure at warning as closely as advisable. The determination of the fusing points of different alloys used under different conditions had been determined by laboratory experiments before use on the boiler.

7 No hydrogen was found to be produced when hot water was forced against the overheated boiler surfaces, although nitrogen was obtained from air that had leaked into the shell and formed iron oxide.

8 One boiler of iron and another of copper, $8^1/_2$ in. diameter and 12 in. long, were exploded by gradual increases of pressure produced by the burning fuel, and one of these ruptures was violent. The iron shell was 0.02 in. thick and the copper, 0.03 in., and the heads were 0.05 in. thick. This showed that the most violent explosions may occur from a gradual increase in pressure.

9 The repetition of Perkins' experiments on the repulsive force between particles of intensively heated iron and steam showed that there was a temperature of maximum vaporization and that there was a repulsive force between the water and the iron.

10 The safety valve may discharge slightly above or below the calculated pressure of discharge.

11 The committee collected data showing the overheating of metal by presence of scale on the shell from deposits of salts in boiler water.

12 Experiments were made to determine the temperature of saturated steam at various working pressures, and these results were compared with those of Robinson, Ure, Taylor, Southern, and the French Academy.

Part 2, called the General Report, appeared in the *Journal* for October, 1836, and outlined the procedure of the tests, noting that the experiments "have shown not only what are some of the causes of explosions, but, which is quite important, what are certainly not causes."

In studying the reports of explosions sent to them, the Committee had difficulty in procuring satisfactory testimony in regard to details because many witnesses were victims of the catastrophies and even to survivors, the precise antecedent conditions were imperfectly known. Hence the Committee selected such cases as they found to bear on the points for which they were cited. The Committee had no theories to support; they were not biased in the selections made.

The Committee added a footnote near the beginning of the report to the effect that the imperative measures proposed were put forth with a view to free discussion, without which they would feel entirely unwilling that it should be adopted. They proposed to distribute the report as widely as possible and invite especially a discussion of its provisions in the *Journal of The Franklin Institute*.

The Committee then discussed the causes of explosions under five general divisions:

1 Undue pressure under gradual increase
2 Presence of unduly heated metal
3 Defects in construction of boilers or appendages
4 Carelessness or ignorance of those intrusted with management of steam engines
5 Collapse of boiler or flue by rarefaction within.

Each of these divisions is discussed with full details from

which are shown the needs of a proper pressure gage for high pressures; the importance of a glass water gage; the unreliability of try cocks with foaming; the necessity of having two safety valves, one of which is inaccessible for alteration; and the required relative sizes of safety-valve disks. The Committee stressed the arrangement of the lever safety valve for a blowdown, the use of fusible metal not in contact with steam, the danger from boiler scale, the need for frequent internal examination, the need for low-water alarms, the danger of cross connections of boilers below the water line, and care in selecting shapes for boilers.

FEDERAL LEGISLATION PROPOSED

The second part of the report was approved Sept. 21, 1836, and it was followed by a proposed form of a bill for the Congress of the United States for regulating boilers and engines of vessels propelled in whole or in part by steam. The bill covered, among other things: enrollment; licenses for navigation; penalties; appointment of an inspector of boilers and machinery and his duties; and the certificate, from owner or master to inspector, of pressure intended, and safety provisions for boilers (two safety valves, graduation of one, maximum pressure on it, regulation of the other to be enclosed and inaccessible except by the captain and under his control, and least rise of second). The proposed law covered in addition: form of lever valve; fusible-metal apparatus; inspection; and penalties (for interference, for bursting from deposits, for master or engineer for gambling or being intoxicated, failure to have inspection, and dismissal of inspector for false certificate).

FRANKLIN INSTITUTE TESTS ON MATERIALS

The last portion of Part 2 of the report of the Committee of The Franklin Institute was published in the *Journal* in 1837, beginning in the February number and continuing until August, 1837. It was made by the members of the subcommittee to whom was referred the examination of the strength of materials employed in the construction of steam boilers. The examinations were made by Messrs. A. D. Bache, Walter R. Johnson, and Benjamin Reeves.

Sixty-six experiments were conducted on eight different specimens of copper, giving a mean strength of 32,826 psi with less than 4 per cent variation for temperatures between 62 F and 82 F, and 39 different experiments at 19 different temperatures as high as 1032 F. These show the decrease of strength to 10,878 psi with an increase of temperature to the high point.

The tests for the strength of boiler iron at or near the same temperatures are given in 32 tables in which 517 fractures are reported. The average strength of one hammered plate was the greatest, 57,676 psi, while that of piled iron was 45,914 psi and that of puddled iron was 52,341 psi. Nineteen tables give results on plates with the grain and across grain, hammered and upset bars, cast steel, cast iron, annealed iron, bars, English cables, bolt iron, iron wire, and Russian and Swedish iron bars.

The wrought iron tested at varying temperatures up to 1317 F showed that with an increase of temperature, the strength increased up to about 570 F and then decreased to 18,913 psi from 60,398 psi. The results were analyzed according to the nature of the pig from which the iron was made, showing that the so-called lively gray pig gave the strongest iron and mixed metal the least strength.

The report covered the variation of strength in relation to direction of rolling; specific gravity; the calibration of condensers; the determination of elongation, elastic limits, and reduction of area; the construction of the testing machine; heating apparatus; and descriptions of methods of testing.

Appointed on Jan. 4, 1831, the subcommittee constructed its apparatus and began experiments on April 4, 1832, making its last experiment Jan. 5, 1837. The results of these were given in 102 tables.

REPORTS OF BOILER EXPLOSIONS

In the *Journal of The Franklin Institute* after 1839, as well as in *The Engineer* (British, founded in 1856), in *Engineering* (British, founded in 1865), in *Power* (American, founded in 1880), in the Transactions of The Institution of Civil Engineers (British, founded in 1828), and of The Institution of Mechanical Engineers (British, founded in 1847), there are records of many explosions from various parts of the world and notes regarding the strange theories of the causes of explosions which continued beyond the mid-century.

It is reported that Linsay in his "Merchant Shipping," vol. 4, p. 140, quotes from the St. Louis *Republican* and the *Insurance Reporter* that between 1816 and 1848 no less than 233 steamboats employed on American waters exploded—and the loss of life amounted to 10–13 persons per accident, the total being 2563 persons killed and 2097 persons injured. He states that, according to Parliamentary Papers, vol. 47, p. 273, the marine explosions in the United Kingdom between 1817 and 1839 numbered 13, with 73 deaths.

STEAMBOAT INSPECTION SERVICE INSTITUTED

That the work of The Franklin Institute was meeting with approval by others is shown by passage of the U. S. Act of July 7, 1833, entitled "An Act to Provide for the Better Security of the Lives of Passengers on board of Vessels propelled in whole or in part by Steam," which first established local inspectors of hulls and boilers. Boilers were required to be inspected once in every six months, and certificates as to the soundness of the boiler were required from the inspectors. This led to the "Steamboat Act" of 1852. By this act the Steamboat Inspection Service under the Secretary of the Treasury was appointed to establish rules and regulations for the uniform administration of the Steamboat Inspection Laws.

BOILER INSPECTION AND INSURANCE IN GREAT BRITAIN AND EUROPE

Approval is also shown by a paper of William Kimbal Hall before The Institution of Civil Engineers of Great Britain on the "Causes of Explosions of Steam Boilers" as reported in *The Engineer* in 1856. He stated that "the inherent deficiencies in designs and materials which could be determined by preliminary testing and by periodic examination were the chief causes of explosions." That others took this view is clearly seen by the number of steam users in Great Britain and Europe who formed associations for the inspection of boilers and the insurance against losses from explosions. One of the first of these was the Association for the Prevention of Steam Boiler Explosions and for Effecting Economy in Raising and Use of Steam, organized in 1855. In *The Engineer* for Sept. 30, 1859, the report of this association shows 574 mills and other plants on the lists with 1611 boilers, and at the monthly meeting inspections of 765 boilers and 572 engines were reported. Twelve cases of corrosion were reported, of which 2 were dangerous; 15 fractures with 2 dangerous; and 38 safety valves, 13 pressure gages, 18 water gages, 5 feedwater devices, and 22 furnaces which were defective. Of 10 defective blowoff systems, 3 were dangerous; and 4 boilers were found with low water. There were 50 boilers without water glasses, 65 without back-pressure valves, and 12 without pressure gages. In four cases the fusible plugs were either wrongly placed or sealed over. Similar reports of this association are found in *The Engineer* and *Engineering* and in the Proceedings of The Institution of Civil Engineers for different years, as well as in reports of such bodies as the Association for the Prevention of Steam Boiler Explosions (1858), the Manchester Steam Users Association (1859), the

Midland Steam Boiler Users Association (1862), the National Boiler Insurance Company (1864), and the Boiler Insurance and Steam Power Company, The Alsatian Association of Proprietors of Steam Boilers, Steam Users Association of Normandy, Silesian Boiler Inspection Association, Societé Industrielle de Marseilles, and Societé Industrielle de Muelhouse.

BOILER INSURANCE IN THE UNITED STATES

In the United States there appears to have been no organization of boiler users devoted to inspection and insurance as had been the case in Great Britain from 1855; but in 1866 the Hartford Steam Boiler Inspection and Insurance Company was founded for such purposes under a charter granted by the Connecticut Legislature on May 2 and approved on June 30, 1866. The organization meeting of this company was held in August, 1866, and the first policy was issued on Feb. 14, 1867. The company trained inspectors and established procedures; and it has continued writing insurance on boilers and has carried on inspection to the present day. During this long period it has published *The Locomotive*, in which have appeared data and discussions relating to boiler operation and construction and lists of explosions and results of inspection. Its publication, "The Boiler Book," contained the basic rules for the design of boilers and other pertinent matters, such as settings.

In 1876 the Knickerbocker Plate Glass and Accident Insurance Company was organized in New York. Later it became the Knickerbocker Casualty Insurance Company, and subsequently, the Fidelity and Casualty Company of the present day. Among the other companies now inspecting and insuring steam boilers the following are noted: Eagle, Globe, and Royal Indemnity Companies, Employers Liability Assurance Corporation, Lumbermen's Mutual Casualty Company, Maryland Casualty Company, Mutual Boiler Insurance Company, Ocean Accident and Guarantee Company, and Traveler's Indemnity Company.

The data collected by the Hartford Steam Boiler Inspection and Insurance Company from their own files and from press reports indicate the probable number of boiler explosions in the United States from 1866 to 1930. The data do not include such minor losses as those resulting from tube ruptures, cracked headers, and similar failures. Moreover the company believes that all explosions have not been included in the list as some reports were not available to them. The list will be found in Table 1.

In examining Table 1 it must be remembered that the number of boilers in the United States has increased each year. The last census giving this information in 1880 reported 72,304 boilers in use and the estimate for 1890 was given in *The Locomotive* as 100,000. It is to be noted also that the figures in the table are comparable with the explosion reports given in *Power*.

The 155 explosions in 1885 are divided between 33 at sawmills and woodworking shops; 20 at mines, oil wells, and collieries; 18 at distilleries; 16 on steamboats and tugs; 16 portable, hoister, and agricultural boilers; 10 on locomotives; 10 at rolling mills and iron works; 10 at flour mills and elevators; 3 at paper mills; 1 at a textile mill; and 18 miscellaneous. The sawmills and agricultural boilers usually accounted for a large number of explosions each year.

SOME DISASTROUS BOILER EXPLOSIONS

Most of the explosions listed were accompanied by the loss of life of one or two persons, a number of injured, and the destruction of one boiler. Of the most disastrous explosions in so far as fatalities and plant demolition are concerned, three will be mentioned. The most disastrous explosion was that which occurred on the steamboat *Sultana* on the Mississippi River above Memphis on April 27, 1865. The boat was built in 1860 in Cincinnati. It left New Orleans on April 21, 1865, with a passenger list and crew of 200. At Vicksburg it took on 2000 Federal soldiers released from the prison camps of Alabama and Georgia. When seven miles above Memphis, at about 3:00 a.m., one boiler exploded. The boat immediately caught fire and in 20 minutes burned to the water's edge with the loss of life of 1500 persons.

On July 25, 1887, in upper Silesia at Friedenshutte, 22 boilers of the elephant type were destroyed by an explosion, probably caused by furnace gas. The death toll was 12; 30 persons recovered from serious injuries. On Oct. 11, 1894, at a coal mine at Shamokin, Pa., 27 of a total of 36 plain cylindrical boilers, exploded. The boilers were of the plain shell type, 34 in. in diameter, 44 ft long, and arranged with three boilers over one grate. Two such groups formed a battery. With this loss in equipment, the human toll was not great, 5 killed and 17 injured.

TABLE 1 BOILER EXPLOSIONS IN THE UNITED STATES

Year	Total	Year	Power	Heat	Total
1868–67	441	1900	329	22	351
1878	not recorded	1901	371	28	399
1879	132	1902	337	31	368
1880	159	1903	298	37	335
1881	159	1904	280	43	323
1882	172	1905	238	24	262
1883	184	1906	209	25	234
1884	152	1907	221	27	249
1885	155	1908	225	23	248
1886	185	1909	264	32	296
1887	198	1910	239	28	267
1888	246	1911	194	40	234
1889	180	1912	192	47	239
1890	226	1913	109	27	136
1891	257	1914	97	48	145
1892	269	1915	99	23	122
1893	316	1916	97	35	132
1894	361	1917	77	32	109
1895	355	1918	81	13	94
1896	346	1919	101	26	127
1897	369	1920	112	38	150
1898	383	1921	114	34	148
1899	383	1922	123	33	156
		1923	110	39	149
		1924	91	24	115
		1925	88	41	129
		1926	87	49	136
		1927	77	31	108
		1928	35	21	56
		1929	51	25	76
		1930	63	52	115

EARLY LEGISLATION ON BOILER INSPECTION

From 1817, at which time the Councils of the City of Philadelphia recommended to the Legislature passage of an act relating to boiler explosions, including inspection, such laws are mentioned a number of times for different American cities. *The Engineer* for Dec. 30, 1859, reports that an ordinance had been submitted to the Common Council of the City of New York to establish the inspection of steam boilers. The first ordinance for the City of Chicago was passed in 1867. Even in 1849–1850 Massachusetts passed a law requiring fusible plugs; in 1880 inspection was authorized with power to condemn; and in 1893 special inspectors were authorized in that state. On June 29, 1889, the Council of the City of Detroit was given power to require and compel the inspection of boilers for operating machinery and to require and compel all operators of boilers to be licensed and bonded. That many boiler inspectors were not reported in the literature consulted is disclosed by the statement in *Power* for September, 1888, that Captain McClellan, inspector of boilers for the City of St. Louis, had issued invitations to boiler inspectors of other cities throughout the country to join in organizing a National Convention of Boiler Inspectors for the purpose of exchanging views as to the

best method of boiler inspection for the better protection of life and property. In *Power* for January, 1889, a statement is made that the National Association of Stationary Engineers objected to the Convention of Boiler Inspectors as an insult to them. The effectiveness of inspection is shown by the experience in Dakota which had no explosions of thresher boilers in the season of 1892 following the passage of an inspection law, while by November of the next season three such explosions had occurred after the repeal of the act by the farmer legislators.

In the last decade of the nineteenth century the licensing of operating engineers and firemen was required in many states.

It is well to note at this point that the steam pressure used in prime movers has varied during different periods of boiler use. From 22 psi in 1830 it increased to 30 psi in 1850, 75 psi in 1870, 80 psi in 1890, and 250 psi in 1900. From the beginning of the present century the average pressures on steam boilers used primarily with steam turbines were 350 psi in 1916, 450 psi in 1921, 550 psi in 1922, and 1200 psi in 1923. At that date the Benson boiler, using tubes bent to shape was built in Great Britain to operate at 3200 psi. By 1930, boilers of the Benson type were in use in Germany.

EARLY RULES FOR SAFE CONSTRUCTION OF BOILERS

During the nineteenth century the national government and the marine underwriters not only prescribed inspection of boilers but formulated rules by which proper designs for safety would result. The British Board of Trade was a committee of the Privy Council of Trade as early as the fourteenth century, and at the middle of the seventeenth century it became a permanent council. After being discontinued twice it was established in 1786 by Orders in Council as a permanent committee of the Privy Council for considering all matters relating to trade and the Colonies. As reconstituted in 1834 it consisted of five departments, the marine department being the one in which we are interested, as it issued the first rules regarding wooden ships, then iron ships, and, with the introduction of steam, rules relating to the inspection and design of ship machinery, including boilers. These construction rules were known at the latter part of the nineteenth century to students of mechanical engineering in America.

In the United States the Steamboat Inspection Service was first carried out under the Department of the Treasury and probably resulted from the investigation of The Franklin Institute for which the Secretary of the Treasury, Hon. Samuel D. Ingham, in 1831, was able to secure the first grant by the United States Government for private research. When the Department of Commerce and Labor was established in 1903, the service was under its secretary, and when a separate Department of Commerce was established in 1913, the Bureau of Steamboat Inspection was placed within that department and under its secretary. In 1942 this service was transferred to the U. S. Coast Guard, under which it functions at present.

To guide inspectors this service prepared rules for the construction of boilers and their component parts. The Congress of the United States provided for the registering of American-owned ships of all types in 1793, of alien-owned steamboats in 1812, and of steamboats owned by incorporated companies in 1825. The Act of 1838 required inspection of vessels propelled in whole or in part by steam, employment of skillful engineers as members of the crew, and the opening of the safety valve whenever the vessel stopped. The Act of 1843 provided for the experimental trial of new inventions for the safe use of boilers and also stipulated the relative strength of copper and iron and the proper way to test a boiler for strength.

The Steamboat Act of 1852 contained the original rules and regulations pertaining to the design and construction of boilers. It authorized the supervising inspectors to receive information from persons with practical knowledge and experience in the construction and use of boilers, the cause of boiler explosions, the collapse of flues, and means of preventing these failures. The rules were adopted under the Act on Nov. 2, 1852, and in 1853 the first table of allowable working pressures was formulated for the standard pressure of 110 psi for 42-in. boilers with $^{1}/_{4}$-in. plates. This Act was amended a number of times, and in the Act of 1871 the office of Supervising Inspector General was established to head the board of supervising inspectors. Regulations were published for boilers built prior to Feb. 28, 1872, and for boilers built after that date. In this set of rules the first formula for the calculation of allowable working pressure in new boilers was prescribed: Taking one sixth of the tensile strength found stamped on the plate, multiplying it by the thickness of the plate, and dividing by the radius for single riveting. Where longitudinal laps of the cylindrical part of the boiler were double-riveted, an increase of 20 per cent was allowed. Then followed minor changes in the rules until 1884 and again in 1905 after the burning of the excursion boat *General Slocum*. The "General Rules and Regulations" prescribed by the Board of Supervising Inspectors were published each year until 1912, with changes and modifications as they occurred.

Other rules for the construction of marine boilers, for the guidance of inspectors of rating institutions, and hence for designers, were issued in the latter half of the nineteenth century.

Lloyd's Register, as constituted at present, has existed since 1835. It originated in 1696 when the marine underwriters met in Lloyd's Tavern in Lombard Street (London) for rating ships. It issued the first printed Register about 1726. A copy dated 1764 is extant. In 1822 the first steamship was registered, and in 1824 the first instruction to steamship surveyors was issued. The first instruction to engineering surveyors appeared in 1874, formed with the aid of representatives of shipbuilders, boiler makers, and builders of machinery.

Bureau Veritas, for similar registry and inspection, was founded in Antwerp in 1828 to make known to underwriters the quality and defects of ships frequenting Dutch and Belgian ports. In 1832 its headquarters were moved to Paris and its use spread to other districts which increased to 250, including 1500 ports. In 1851 it issued Rules for Construction of Wooden Ships; in 1867, for iron and steel ships and also for the construction of machinery and for the testing of materials.

In addition to these registries there were the following:

The British Corporation for the Survey and Registry of Shipping, Glasgow
Bureau Veritas International Registry of Ships, Paris
Germanischer Lloyd, Berlin, 1817
Norske Veritas, Christiania (Oslo), 1894
Registro Nationale Italiano, Genoa, 1861
Record of American and Foreign Shipping, New York
American Bureau of Shipping, 1867
Veritas Austro Ungarrau, Trieste
Great Lakes Register.

In 1873–1876 a United States Commission tested boilers to destruction at Sandy Hook, N. Y. Four old steamboat boilers were tested hydrostatically to rupture, repaired, and ruptured several times to determine weak points. Then they were ruptured by explosion under steam, together with five new boilers. These tests showed that low water is not the only cause of violent explosions; most violent ones may occur with boilers well supplied with water even when pressure is gradually increased, as was shown by the Franklin Institute tests. Even a moderate pressure may cause a violent explosion and then at times below the pressure to which the boiler had been tested.

UNIFORM BOILER SPECIFICATION COMMITTEE OF AMERICAN BOILER MANUFACTURERS ASSOCIATION

The American Boiler Manufacturers Association held its second meeting in Pittsburgh on Oct. 15, 1889. It had been organized six months earlier, not for price fixing but for raising the standards of boiler manufacture and preventing the manufacture and sale of boilers unfit for safe operation. At the first meeting, committees were formed on materials, recommended tests, riveting, tubes, attachments of valves and fittings, and settings. At the annual meeting in Buffalo in 1892, the Association appointed a committee on uniform specification laws. At the meeting in 1897 the Uniform Boiler Specification Committee, composed of E. D. Meier, Henry J. Hartley, George N. Riley, James Topping, and D. Connaly, was appointed to follow the older official specifications in use in Europe and America, which were presented in abstract, only in so far as their requirement could be verified by the actual facts of calculation and of sound current practice. The committee was instructed to eliminate provisions based on mere guesswork. The specifications were to embody new rules which have become "unwritten law" of best American boiler-shop practice as reflected in the transactions of the Association.

The committee met in Philadelphia, May 19, to subdivide the work among its members and at Atlantic City, Aug. 12 and 13, 1898, for co-ordination. At the latter meeting, past-presidents and members of the material committee of the Association aided in the preparation of the report presented at the convention of the Association in October, 1898. To this report five papers by members of the committee and others were appended. The specification covered materials, riveting, factors of safety, calking, flat surfaces, bumped and dished heads, flanging, bending and forming, tubes, tube holes and setting, ferrules, removing old tubes, flues, stay bolts, braces, manholes, domes, drums, hanging, and hydrostatic-pressure tests. As one reads the description of this specification, it appears to be well arranged and covers a safe design for adoption. An insurance engineer has stated, however, that it was planned for uniformity in bidding rather than uniformity for state adoption. Col. E. D. Meier, president of the Heine Steam Boiler Company, and also president of the Association in 1909, who was chairman of the Uniform Specification Committee, was looking always toward adoption by the states as its purpose and greatly regretted the refusal of approval by some members of the Association who would not look beyond the interests of their own companies.

THE MASSACHUSETTS RULES

As the twentieth century began there lay behind it a harrowing record of loss of life and property from boiler explosions throughout the United States. Although boiler explosions occurred to a lesser degree in some other countries, inspection had become the rule, licenses for firemen and boiler tenders were being required after examinations, rules for marine-boiler construction had been formed by government and registry agencies and were studied in the courses on boiler design in many of our schools, and the Boiler Manufacturers Association had been thinking of uniform specification for safe stationary boilers, there was as yet no legal code for safe stationary boilers in any of the states of the nation.[1]

In the report for the year 1902, the chief of the Massachusetts district police reported that there had been no boiler explosions in the state for four or five years, though the Hartford Steam Boiler Inspection and Insurance Company reported for the United States 1600 explosions in which 1184 persons were killed during those four years. The Massachusetts record continued to be good until March 10, 1905, when a fire-tube boiler exploded in a shoe factory in Brockton, Mass., resulting in the death of 58 persons, the injury of 117, and $250,000 property damage, with $280,000 of claims for injury and death. This catastrophe clearly indicated that a more complete boiler law was required, although it was too late to introduce one into the Legislature then in session.

Early on the morning of Dec. 6, 1906, an explosion occurred in a shoe factory at Lynn, Mass., resulting in one death and several injuries and a property damage estimated at $422,000. On Dec. 22, 1906, Joseph H. McNeill, chief inspector of boilers for the State of Massachusetts, reported the details of this explosion to the chief of district police and concluded with the statement: "This Department under your direction and in conference with authorities on these matters should be empowered to formulate rules and regulations governing the maximum working pressure allowed, the appendages to be placed, and the quality of material and workmanship entering into the construction of steam boilers, such rules and regulations, when approved by the Governor, to become law, and to apply to all boilers manufactured in the State or coming into the State, excepting boilers on locomotives, in private residences, or under the jurisdiction of the United States."

Within two weeks, on Jan. 3, 1907, Governor Gould in his inaugural address asked for immediate action on this matter. On May 29, 1907, House Bill 17, which became Chapter 465 of the Acts of 1907, was approved by the Governor. It included a provision for his appointment of a Board of Boiler Rules, consisting of five men. This was the first state law in the United States for the regulation of the construction and installation of boilers.

The first Board, appointed on July 5, 1907, consisted of Joseph H. McNeill, chairman; John A. Stevens, representing boiler-users' interests; Frederick H. Keyes, boiler-manufacturers' interests; Robert J. Dunkee, boiler-inspectors' interests; and William M. Beck, boiler-operators' interests.

FIRST MASSACHUSETTS RULES APPROVED AUG. 30, 1907

The first rules formulated by the Board were approved by Governor Gould on Aug. 30, 1907. They had resulted from ten meetings of the Board and consisted of three pages, one containing the facsimile of the standard form of certificate of inspection with a second page relating to fusible plugs and their location. The third page gave rules limiting the pressure on boilers constructed wholly of cast iron to 25 psi and on boilers with cast-iron headers to 160 psi, and other rules relating to the shearing strength of rivets and factors of safety.

Following the issuance of these few rules the committee met during the latter part of 1907 and throughout 1908, adding other rules, so that by Jan. 1, 1909, there were six editions.

On the edition of 1909 a legislative hearing was held. Dr. D. S. Jacobus, of The Babcock & Wilcox Company, at the suggestion of Mr. E. R. Stettinius, its vice-president, appeared before the committee as a representative of a manufacturer but without any instruction from the officers of his company. At the hearing on the first day some users of boilers protested that the rules would be a hardship on the grounds of needless expense and the proposed rules were severely criticized by some boiler manufacturers. Mr. John A. Stevens, of the Board of Boiler Rules, met Dr. Jacobus outside the committee room, and not knowing what would be said by the representative from New York, expressed himself forcibly against someone coming all the way from that city to kill something in Massachusetts. On the second day, at the request of the legislative chairman, Dr. Jacobus stated that his company would be willing to co-

[1] It is well to note that from Jan. 14, 1869, the City of Detroit had a very effective and complete ordinance relating to inspection and care of steam boilers and their operation by properly licensed firemen.

operate; that while there were details of the rules that should be changed, the fundamental ideas advanced were all right; and that he felt sure the committee, which included Prof. Edward F. Miller, of the Massachusetts Institute of Technology as one of its consultants, would revise the rules to remedy any objectional features. On the conclusion of these remarks, which were the first of any indorsing the code, a member of the committee asked why a boiler concern in New York had come all the way to Boston to say it was in favor of the rules. Dr. Jacobus replied that although he had received absolutely no instructions he knew the policy of his company was to act in the broadest possible way and that it would indorse a movement for the protection of human life and property. Following this, others spoke in approval of the rules.

The Massachusetts Rules of 1909 were bound with the act relating to the examination and licensing of engineers and firemen, and a detailed act relating to the operation and inspection of steam boilers. These rules were formulated by the Board of Boiler Rules in accordance with provisions of Section 26, Chapter 465, Acts of 1907, as amended by Chapter 393, Acts of 1909, "An Act Relating to the Operation and Inspection of Steam Boilers." There were three parts to the rules. Part 1, in addition to Part 2, applied to boilers installed on or before Jan. 1, 1909. For steel and wrought-iron boilers it fixed the determination of the maximum allowable pressure and its computation with a factor of safety of 4.5, tensile strength of 55,000 psi for steel and 45,000 psi for wrought iron, and the areas of rivets when size was not known. It also fixed sizes of non-spring-loaded safety valves and bottom blowoff valves. Part 2 referred to boilers installed "now and in the future." It defined maximum pressure for cast-iron boilers at 25 psi, for boilers with cast- or malleable-iron headers, or with cast-iron mud drums, at 160 psi, and for State Boiler Department lock-pop safety valves on boilers for heating purposes at 25 psi. The strength of rivets, the factors of safety of 6 to 5 for boilers of different ages, and the number and size of safety valves were prescribed. Requirements were given for fusible plugs, steam gages, water gage glasses and gage cocks, feed piping, stop valves, damper regulators, lamphrey fronts, and valves on return pipes. Horsepower rating, annual external and internal inspections, hydrostatic pressure tests, efficiency of joint, welded joints, and forms of certificate were covered in separate sections.

Part 3, referring to boilers for the future, gave the requirements of materials to be employed in the construction of different parts of the boiler. It described the details of stamping boilers which met the requirements of the code, the determination of maximum allowable pressure from efficiency of joints or ligaments, staying of heads, longitudinal joints, thickness of plates, and bumped heads. It also gave requirements for stay bolts and loads, furnaces of vertical boilers, staying of segments of heads, nozzle thickness, rivets and riveting, calking, tube holes and ends, and threaded openings. These were followed by rules for manholes and handholes, method of support, settings, safety valves, stop valves, piping for feed, blowoff, water column, and steam mains, clean-out doors, nonstandard boilers, and portable boilers. Part 3 was followed by appendixes relating to the care and operation of boilers and recommendations to be used in boiler construction.

OHIO RULES APPROVED

On Oct. 24, 1911, Governor Judson Harmon of Ohio approved the Rules formulated by the Ohio Board of Boiler Rules, C. H. Wirrnel, chairman, Chief Inspector of Boilers; George H. Kittol, boiler manufacturer; H. A. Baumharp, insurance interests; Joseph P. Owens, boiler-users' interests; and Frank H. Yeager, boiler-operators' interests. Previous to this, Ohio House Bill 248 established a Board of Boiler Rules and their powers and duties, and also the matter of inspection. This bill was passed on May 31, 1911, and approved by Governor Harmon on June 14, 1911.

The Board of Boiler Rules adopted with few changes the Rules of the Massachusetts Board so that little time was needed for the preparation of the Ohio Rules and they could be presented for adoption and approval by the Governor on Oct. 24, 1911, as mentioned. Part 1 was applied with Part 2 to boilers installed before Jan. 1, 1912; Part 2, in addition to Part 1, applied to boilers installed after July 1, 1912. Boilers so installed were governed by Part 1 and the Rules of Part 2 governed the installation of all appliances. Part 3 covered the same matter as Part 3 of the Massachusetts Rules and went into effect after July 1, 1912.

The various sections of the Ohio Rules are practically the same as those of Massachusetts with few changes and additions. It was thought that the 1909 Rules were excellent and by following these, Ohio would have the same protection as the Bay State. Thus Ohio became the second state to have a law for more uniform and safer boiler construction than had existed before 1911.

Thus in the 80 years that had intervened since The Franklin Institute began its pioneering and public-spirited attempts to reduce boiler explosions, the groundwork was laid on which, from 1911 to 1915, The American Society of Mechanical Engineers was to develop the ASME Boiler Code. How difficult a task that turned out to be is described in the second chapter of this history.

Industrial Engines Standardized

AS OF July 1, 1952, the military department will have specifications and standards ready for procurement purposes on industrial gasoline engines, having 3 to 4-in. bore sizes. This announcement was made by Russell A. Moody, director of the Munitions Board Standards Agency of the Department of Defense, in reply to industry requests for several months, advance notice on military conversion to use of standardized industrial internal-combustion engines developed under the Standards Agency engine-standardization project.

The project was established to provide interchangeability of parts regardless of engine make. It will encompass automotive, industrial, and military-type engines. Industry and military working groups have completed the first segment of this work, replacing 1187 different commercial parts with 59 standardized parts.

The study has been based on the premise that existing production capacity must be used to the maximum.

Rear Admiral J. W. Fowler, USN, director of the Munitions Board Supply Management Agencies and chairman of the Industry Advisory Group of 23 members which conducted the project, expressed appreciation for the group's work and conveyed the praise of the Hebert Subcommittee of the House Armed Services Committee.

Twelve manufacturers are currently building these engines for test purposes under 25 military contracts. In order to expand the production base, the Munition Board representatives urged all producers of industrial engines to prepare to produce the new standard engines. To qualify as suppliers, their engines will be required to pass certain tests.

Testing can be arranged through either the Office, Chief of Engineers, Research and Development Division, U. S. Army, or the Munitions Board Standards Agency, both in Washington, D. C.

Conditioning of NATURAL GAS

By J. C. BOEHM

TRANSCONTINENTAL GAS PIPE LINE CORPORATION, HOUSTON, TEX. JUNIOR ASME

INTRODUCTION

GAS conditioning is actually a simple problem in arithmetic. By processes of addition and subtraction, natural gas is given qualities to make it more transmissible and more desirable to the customer. At the same time, the gas producer and pipe-line company get the maximum benefits from the gas.

From another angle, gas conditioning is like marriage; the pipe liner has to live with the gas. When he can, he changes it to make the living easier; for natural gas is typically feminine in that there are many kinds—all similar but no two alike. It is in all cases a mixture of several gases.

No particular combination of natural gases predominates, so there is no typical natural gas. Methane and ethane constitute the bulk of the combustible and desirable gases, with the methane content varying from 60 to 95 per cent. Ethane, propane, butane, hexane, and so on, follow, respectively, in decreasing percentages.

Carbon dioxide and nitrogen comprise the bulk of the inert gases. The CO_2 content ranges from a trace to 100 per cent in some wells in the Rocky Mountains area, while the nitrogen content has been reported at an average of 7.9 per cent by volume for the various fields in the United States.

Helium is also found in natural gas, being usually less than 1 per cent when it occurs.

Some gas fields produce gas containing hydrogen sulphide and such sulphur compounds as mercaptan. When a gas contains hydrogen sulphide it is called "sour gas," when it doesn't, it is called "sweet gas." If hydrogen sulphide is found, the quantity by volume usually varies from a trace to 10 or 15 per cent. One per cent hydrogen sulphide by volume is the equivalent of approximately 0.1 lb of sulphur per 100 cu ft. Finally, in almost every case, gas when produced is saturated with water vapor at the pressure and temperature prevailing in the producing zone.

In Table 1 are the analyses of ten gases purchased by Transco. Two of these gases, E and K, go through gasoline plants before being delivered to Transco. Notice the effect of this processing on the amount of propane, butane, and higher hydrocarbons left in the gas. Also note the generally high methane content in all cases.

Table 2 is a comparison of the gases Transco purchases in Texas showing how the seller conditions the gas before delivery to Transco. In the second column are listed the kinds of gases, classified according to original source, that is, unassociated, associated, or gas distillate.

Gas purchased by a transmission company is either residue gas from a processing plant or comes directly from the well. In the latter case, the well may be a gas well or an oil well and the gas classified as associated or unassociated, depending on whether or not the gas is associated with oil. Associated gas, or casinghead gas, is in solution with the oil underground or exists as a free gas cap above the oil. Further, the gas may be wet or dry, depending on its natural gasoline content. Wet gas or casinghead gas contains gaseous vapors which will condense into natural gasoline. The term wet usually indicates more than 0.1 gal of gasoline per 1000 cu ft of gas. Gas wells producing wet gas are commonly referred to as distillate wells.

In so far as a transmission company is concerned, gas is conditioned by the following: (1) Removing water, or dehydration; (2) removing liquid hydrocarbons; (3) removing hydrogen sulphide; (4) removing inert gases; (5) removing such foreign matter as dirt; (6) or adding an odorant.

DEHYDRATION

Let us first examine removing water, or dehydration. Gas comes from the well saturated with water vapor and also picks up water either as a vapor or in droplet form from processing equipment or from the pipe line itself where water collects in low spots.

To find out how much water there is, Dalton's law can be used when pressures are near atmospheric, however, at the higher pressures at which pipe lines are operated, experiment has shown that there is considerable deviation from the calculated results. Actually, saturated gas carries about 40 lb of water per million cu ft when delivered to the pipe line at the usual 75 to 125 F temperatures and 800 to 1000 psi pressures.

Usually water-vapor content in the air is spoken of as "humidity" or "per cent of humidity." But when discussing water-vapor content in relation to gas dehydration, the "dew-point temperature" or more commonly "dew point" is used as an index. The dew point is the temperature at which moisture condenses under constant pressure conditions; or, if preferable, it is the saturation temperature of a gas at a specified pressure.

To illustrate the relationship, assume that a pipe line receives saturated gas at 1000 psig and 60 F. The gas has 100 per cent humidity and contains 18 lb of water per million cu ft of gas. At some point downstream the gas is still 60 F but the pressure has dropped to 500 psig. The moisture content has not changed, but the moisture capacity has. It can now hold 28 lb of water per million cu ft. Thus the humidity is only 64 per cent.

To show how much the moisture content of a gas may be lowered, the term "dew-point depression" is used. Referring to the point on the pipe line where the gas was at 60 F and 500 psig, a 40-deg dew-point depression means that after being dehydrated the gas would have to be cooled at a constant pressure to a temperature below 20 F before additional condensation would occur. This means removing 20 lb or $2^1/_2$ gal of water per million cu ft saturated gas; and so lowering the water content from 28 to 8 lb per million cu ft.

Control of moisture content in any pipe line depends on correct dew-point measurement. Since most dew-point measurements rely upon the skill of the operator and the accuracy of

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TABLE 1

COMPARISON OF COMPOSITION OF NATURAL GASES SUPPLIED TO TRANSCONTINENTAL

	Mol per cent									
	Gas A	Gas B	Gas C	Gas D	Gas E	Gas F	Gas G	Gas H	Gas J	Gas K
Carbon dioxide	0.80	0.60	0.80	0.50	0.40	0.70	0.60	0.80	0.70	0.22
Nitrogen	0.27	0.17	0.24	0.10	0.23	0.71	0.25	0.32	0.27	0.06
Methane	93.14	94.22	93.18	94.87	94.45	92.99	93.42	93.70	93.40	95.19
Ethane	3.95	2.87	3.85	2.94	4.11	3.57	3.76	3.55	3.87	3.48
Propane	1.09	1.08	1.12	0.74	0.66	1.10	1.15	0.89	1.07	0.72
Iso-butane	0.20	0.18	0.24	0.26	0.03[a]	0.27	0.28	0.17	0.21	0.10[a]
N-butane	0.22	0.33	0.24	0.23	0.04	0.29	0.24	0.22	0.19	0.09
Iso-pentane	0.09	0.12	0.09	0.10	0.02	0.08	0.11	0.09	0.08	0.04
N-pentane	0.06	0.10	0.06	0.07	0.01	0.07	0.06	0.07	0.05	0.03
Hexanes	0.10	0.15	0.12	0.11	0.03	0.08	0.08	0.08	0.09	0.05
Heptanes plus	0.08	0.08	0.06	0.08	0.02	0.14	0.05	0.11	0.07	0.04
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[a] Gas E received from hydrocarbon-recovery plant. Major portion gas K received from hydrocarbon-recovery plant.

TABLE 2

COMPARISON OF SOURCES OF NATURAL GAS—TRANSCONTINENTAL (TEXAS)

Type conditioning prior to delivery to Transco	Kind of gas	Number of sources	Quantity purchased, MCFD
(*a*) Mechanical separation	Unassociated Gas distillate	9	50400
(*b*) Mechanical separation and dehydration	Unassociated Gas distillate Associated	19	168100
(*c*) Dehydration	Unassociated	1	4000
(*d*) Hydrocarbon recovery (absorption and dehydration)	Unassociated Gas distillate Associated	21	141000
(*e*) Hydrocarbon recovery (absorption)	Unassociated Gas distillate	5	98000
		55	461600

his observation, the possibility of human error cannot be neglected.

The essence of a dew-point instrument is that a small stream of gas is directed against a mirror which is gradually cooled during the test. The appearance of dew on the mirror is observed through a pressure-tight window. Of course, the instrument is equipped with a thermometer, a pressure gage, and a cooling element.

Water is removed because it cannot be sold; it encourages corrosion and it forms gas hydrates.

A gas hydrate is a crystal that forms at critical pressures and temperatures when the gas is saturated with water vapor. The water molecules combine with the gas molecules, especially propane and butane, to form hydrate crystals. Once started the hydrate grows, crystal by crystal. As it grows it restricts the flow and causes a greater pressure drop; this in turn increases the expansion and cooling—all of which accelerate the growth of the hydrate. Eventually the hydrate will completely plug the pipe line or the valves, fittings, or flow regulators where it has formed. Since the hydrate looks like hard-packed snow, the formation of a hydrate is usually referred to as a "freeze-up."

Bearing in mind that most pipe lines operate at comparatively high pressures, it is disconcerting to realize that hydrates form at increasingly higher temperatures as the gas pressure increases. A 0.6 specific gravity gas at 800 psia will form hydrates at 58 F—the same gas at 150 psia can operate at about 35 F even when wet.

The best cure for hydrates is prevention by dehydrating all the gas taken.

One study of gas-dehydration processes shows 21 different kinds. Of these, present-day practice favors two: (*a*) absorption by a glycol solution, or (*b*) adsorption by a solid granular desiccant. Process (*a*) involves a liquid; process (*b*), a solid.

A typical glycol dehydration installation consists of an inlet-gas scrubber and absorber, a fractionator and reboiler, and a cooler, intermediate heat exchanger, pumps, and controls.

Plant operation is comparatively simple. The glycol solution, or drying agent, is pumped into the absorber tower near the top. It flows across each bubble tray and down a pipe to the next, thus descending the tower. Wet gas comes in the bottom, gets scrubbed, and then rises to the top. While flowing upward through the bubble caps, it mixes intimately with the glycol solution which absorbs the water. It leaves any entrained glycol in the liquid extractors and passes out the top as a dry gas.

The lean or dilute solution of glycol is collected at the bottom of the absorber. It is pumped through the heat exchanger and a preheater into the fractionator tower. Here, the water is stripped and the water vapor separated. The concentrated solution is then returned to the absorber.

Diethylene glycol and triethylene glycol are the most commonly used liquid desiccants. Diethylene glycol is a hygroscopic, odorless, and practically colorless liquid; triethylene glycol is similar but has a higher boiling point and a correspondingly lower volatility, making it good for high operating temperatures. With a 96 per cent solution of diethylene glycol a dew-point depression of 40 to 60 F can be obtained.

The inlet-gas scrubber, which is usually in the bottom of the absorber tower, removes from the gas stream liquids and solids that would foul and plug the bubble trays, lines, and control valves.

Most absorbers are of the bubble-tray type. Just above the

trays are two liquid extractors in series. The first is probably a centrifugal fin type to handle high liquid loads and remove the bulk of the glycol spray from the dehydrated gas. The other is a mist extractor which is usually a layer of ceramic packing between screens, although sometimes this is made of an expanded-metal lath. Operating pressures in absorber towers range from atmospheric to 1500 psig.

The fractionator tower has a series of bubble trays just above the feed plate; below is the stripping section. Occasionally the top is cooled. Operating pressures are from 0 to 15 psig.

The reboiler, located near or at the base of the fractionator column, provides heat for the column. High-pressure steam, Dowtherm, or hot oil are commonly used sources of heat, as are direct-gas-fired reboilers.

Operating conditions determine the type of heat-exchange equipment but shell-and-tube types are quite common.

Pumps to circulate the glycol solution are, most frequently, reciprocating double-acting piston pumps, or single-acting plunger pumps. Centrifugal pumps do not satisfy the requirements of a high discharge head and low fluid volume.

A glycol installation is easily put into automatic operation and the degree to which it is automatic determines the amount of control and instrumentation. Most important is a control to provide a constant circulation rate on the pump. Then there are liquid-level controls and top-temperature controls as appropriate.

Transcontinental dehydrates by the second-type process; that is, adsorption by solid desiccants. In this process the phenomenon of adsorption occurs without any chemical action and without intimate mixing of the water and solid. Two contacting beds are required for this process; while one is dehydrating, the other is regenerated.

Depending on capacity, Transco's contactors vary in diameter from 2 to 4 ft and are from 12 to 16½ ft tall. The dehydrators are all skid-mounted so they can be moved easily from location to location.

An inlet separator removes entrained liquids and solids from the gas, while a water separator removes accumulated moisture from the regeneration gas. The units are equipped with flow temperature and time-cycle recorder controllers that open and close diaphragm-operated valves. The controllers are all spring-driven, making the dehydrator automatic.

Having passed through an inlet scrubber, the wet gas flows down through the bed of dry desiccant and out into the pipe line. The desiccant gradually adsorbs moisture until it is saturated. Then it must be reactivated or regenerated.

To regenerate, a side stream of wet gas is heated in a gas-fired heater to about 375 F and passes upward through the idle contactor. The water, driven from the desiccant by the heated wet gas, is removed when the gas is cooled in the cooler and wasted into a pit. The regenerating gas enters the main stream to be dehydrated.

The contactor cycle is 8 hr dehydrating and 8 hr being regenerated. During the last 3 or 4 hr of regeneration the regenerating gas is not heated and so cools the bed.

The desiccant is "florite," an activated bauxite. This is one of the general types used. The other commonly used desiccant is activated alumina. These materials are hard, highly porous, and noncorrosive; even when saturated they seem perfectly dry. The high sorption capacity stems from the capillary structure in the granule. Recently, another solid-type desiccant derived from silica has been developed and is sold under the trade name of "sovabead." The capacity of the various desiccants when fresh is from 8 to 11 per cent by weight.

Transco has 15 dehydrators, the smallest of which will handle 5,000,000 cu ft per day of gas, with a total charge of 2116 lb of florite. The largest dehydrator, handling 30,000,000 cu ft per day, requires 15,100 lb.

About 15 to 20 per cent of the total gas flow is used for regeneration. While this gas is not lost, the fuel gas is consumed, naturally, and amounts to 0.10 to 0.15 per cent of the total flow. Characteristic operating conditions are as follows:

Gas in	Gas out
1 Pressure 850 psig	1 Pressure 840 psig
2 Temperature 70 F	2 Temperature 90 F
3 Dew point 30 F	3 Dew point −10 F

About 5 lb of water are removed per million cu ft

Choosing between a liquid- or solid-type dehydrator is ultimately a matter of economics and operating conditions. However, the following are some points of comparison:

1 The liquid type operates on a continuous cycle; the solid does not.

2 Solid desiccants will dehydrate gas more completely, giving dew-point depressions of 100 F or more where the glycols yield 40 to 60 F depression.

3 Solid types are best used at pressures starting at 500 psig and going to no known limit. Effective pressures for the liquid process range from 0 to 1500 psi.

REMOVAL OF HYDROCARBONS

When pressures rise and temperatures fall, propane, butane, pentane, and the higher hydrocarbons condense out. This condensate is a menace to the pipe line. It collects in the line, decreases the cross-section area, and so impairs the efficiency of the line. The condensate is a breeding ground of hydrates. If liquid hydrocarbons are left in the gas, horsepower will be wasted in moving them. In contact with the operating equipment condensate will cut lubricating oil, deteriorate valve plates, and further harass the compressor-station operators.

On the other hand, the liquid hydrocarbons are valuable. They are a source of raw materials for various chemical products such as butadiene and are used as a fuel for domestic consumption, being marketed as liquefied petroleum gas. Consequently, it pays to remove the liquid hydrocarbons both for efficient pipe-line operation and for their value.

When the quantity of such hydrocarbons is great enough, either the pipe-line company or the producer will build a recovery plant to remove them—otherwise they will be removed by mechanical separators. At first, these liquid hydrocarbons were recovered by compressing and cooling the gas. But today the continuous oil-absorption process has largely supplanted any other type of hydrocarbon recovery. If a gas has over 5 gal of natural gasoline per 1000 cu ft, it probably would be economically feasible to use the compression method. However, for the most part, gas from the large-volume-producing fields contains less than 2 gal of natural gasoline per 1000 cu ft.

In a typical and simplified oil-absorption process, the equipment consists of an absorber tower, stripper section, recovery tanks, coolers, heaters, heat exchangers, and pumps. Absorption oil is a light oil similar to kerosene.

The process resembles the glycol-dehydration process. Rich, raw gas enters the absorber, which is another bubble-tray tower, flows upward through the bubble caps, and mixes with the downcoming stream of lean oil. The lean oil extracts the hydrocarbons, taking ethane, propane, and butane in respectively greater percentages. Residue gas, robbed of the hydrocarbons, passes through a mist extractor and into the pipe line.

The enriched oil is returned from the bottom of the absorber into the stripper, again a bubble-tray tower. The top of the tower is a dephlegmator section; the lower, a stripping section. The function of the dephlegmator is to knock back absorption oil, vaporized in the stripper, by refluxing raw gasoline over the

top of the tower. The stripping section reverses the absorption procedure and drives the gasoline and other lighter hydrocarbons from the oil, using live steam as an agent. The lean oil returns to the absorber and the removed hydrocarbons are carried away.

A word on the usual operating conditions: Absorption is aided by high pressure and low temperatures. Consequently, today's designers and operators are working with increasingly higher pressures, leaving the original 40 to 50 psig and going to 1500 and even 2200 psig. At these higher pressures, less lean oil is required. However, in contemplating a hydrocarbon-recovery plant and the possibility of operating at high pressure, the cost of compression would require an available market or use for high-pressure residue gas. Temperatures are in the neighborhood of 60 to 120 F and to obtain lower temperatures intercoolers are sometimes used.

Stripping is the opposite of absorption; it likes low pressures and high temperatures. Steam is introduced to lower the pressure as well as to provide heat. Usual operating pressures are from 50 to 75 psig and temperatures range from 250 to 350 F.

Residue gas leaving a gasoline plant is invariably warm and saturated with water from the oil, which picked up the water from the steam. Therefore, before the pipe line can take it, the gas must be dehydrated and in turn cooled for effective dehydration.

SULPHUR REMOVAL

Hydrogen sulphide is another undesirable gas which has to be removed. From a customer standpoint it is objectionable since it is almost 6 times as toxic as carbon monoxide. Then, too, in the presence of oxygen and water it will cause severe corrosion of the transmission and consumer equipment. Unfortunately for today's pipe lines, pressure accelerates this reaction. Because of this, gas contracts are written to include clauses defining the limits of allowable sulphur. A typical contract sets the limits at 15 grains of free sulphur per 100 cu ft and $1^1/_2$ grains of hydrogen sulphide per 100 cu ft.

Where formerly the pipe lines scorned sour gas from fields and refineries, the boom in the industry has created a considerable demand for sour gas. At the same time, there has been a marked increase in the national demand for sulphur. Consequently, desulphurization has become a greater problem and a more practiced process.

A liquid scrubbing process, using an amine base, is the most-used continuous process for removing hydrogen sulphide. The use of amines derives from their characteristic of forming salts with hydrogen sulphides at low temperatures. Upon heating, the salts dissociate.

Although the process involves a chemical reaction, in other respects it resembles the glycol dehydration process. In fact, glycols and amines are sometimes combined to form a combination sulphur and water-removal solution. Virtually the same equipment is used—contactor, still, and auxiliaries. Sour gas enters the bottom of the contactor, meets the amine solution and leaves sweetened. The scrubbing solution is freed from hydrogen sulphide by heating. Hydrogen sulphide is then either flared or used in the production of sulphur or a sulphur product.

The amines used are monoethanolamine, diethanolamine, and triethanolamine. Although triethanolamine was developed first and was used first, monoethanolamine is most commonly used since it is most reactive.

NITROGEN REMOVAL

Certain areas in the United States produce gas with a high nitrogen content. Nitrogen in a gas is undesirable because it lowers the heating value of the gas. In consequence, more investment is required to install larger pipe and more compression horsepower. Operation costs are higher because an unsalable product is being moved.

Although much research has been done on it, nitrogen removal, for the most part, is still in the research and development stage. The most likely avenues of approach are either liquefaction and fractionation or hypersorption—a continuous process involving fractionation on a moving bed of activated charcoal.

DUST REMOVAL

Pipe-line dust, which is mostly iron oxide from the pipe walls, has several troublesome characteristics. After combining with oil it clings to the pipe wall, thus reducing the inside diameter of the pipe. By roughening the wall it increases friction and decreases pipe-line efficiency. It fills valve seats and prevents closure. It scores regulators so that they leak. It grinds meter-plate edges causing errors in reading as high as 20 per cent. It erodes compressor valves and valve seats.

There are three ways of removing dust; namely, (*a*) screen filters, (*b*) liquid scrubbers, and (*c*) centrifugal dry scrubbers. Of these, only the last two are suited to large-volume-transmission usage and Transco employs both kinds.

Liquid scrubbing is a continuous operation, employing a very lightweight Diesel oil as agent which, in addition to removing dust, will pick up low-specific-gravity liquids. Each of Transco's 16 reciprocating compressor stations is equipped with a battery of liquid scrubbers.

At the bottom of the scrubber is an oil and sludge accumulator that is easily blown down and recharged with fresh oil. The next section is a gas-oil mixing zone, followed by a disengaging zone where the bulk of the oil is dropped. Next, there is a reservoir to collect oil from the secondary disengaging zone. Oil is drained from this reservoir and injected into the gas stream. Above the reservoir is the secondary disengaging zone, and lastly, a mist extractor to remove the remainder of the oil. The entering gas mixes with the oil and flows upward. The oil collects the dusty particles and they accumulate at the bottom.

In a new line, the scrubber is operated with a high level of oil, forcing the gas to pass through the oil in order to rise in the center. As the line cleans itself, the oil level can be lowered to where the gas just contacts the oil. The through-put rate is greater in this case; 500 to 600 psig are usual operating pressures.

The centrifugal scrubber is a dry scrubber. Transco has a battery installed at Linden, N. J., to scrub the gas before it is delivered to the metropolitan area.

The basis of the scrubber is a small cylindrical tube with a vertical inlet slot. Untreated gas enters the slot tangentially and is given a circular motion. Centrifugal force throws the dust particles against the sides of the tube. The dust then falls down through a cone discharge into a tank. Meanwhile, the clean gas comes out the top of the tube.

The scrubber itself consists of a group of these small tubes mounted in parallel between two tube sheets and this assembly is encased in a tank. The number of tubes depends on the quantity of gas handled. These scrubbers may be either vertical or horizontal.

ODORIZING

After switching to natural gas, some distribution companies have been flooded with customer complaints about the odor. Either it is too gassy or not gassy enough. Very likely the customers do not realize that natural gas has little or no smell. Recognizing the inherent hazard of an explosion from undetected gas, most states have laws requiring that it be odorized to give it a distinctive and alarming smell.

Much research has gone into the development of successful odorants. A Bureau of Mines study revealed that a gassy odor was best and a disagreeable odor was next best. Consequently, the odorant industry has concentrated on offering products with emphatic stenches that will be gassy or disagreeable, usually both.

Cyclic sulphides and mercaptan-type odorants are the two basic kinds in use. Although the mercaptans have the greatest odor strength, they are chemically unstable. The cyclic types, because of their stability, make the best odorants, particularly for long-distance gas transmission. Transco uses a cyclic sulphide odorant, marketed as Calodorant. It is a light-bodied liquid almost water white in color.

Odorizing the gas stream is accomplished either by injecting the odorant or by evaporating it into a gas stream by-passed from the main stream.

At its company houses and smaller sales meter stations, Transco has installed evaporative equipment. A pot or tank holds one or more wicks and the gas stream passing over the wicks carries off the odorant. Additional wicks are added for increasingly larger volumes of gas.

At Malvern, Pa., an injection odorizer is installed which conditions all the gas sold in Philadelphia and the New York area. This unit is to be replaced by a similar injection-type odorizing plant now being built. The new one has a better location, automatic operation, more accurate control, and refinements to eliminate the nuisance of leaking odorant.

A year's supply of odorant is stored underground in 5 tanks. The 6000 gallons storage capacity makes it possible to buy odorant in bulk, delivered by a tank truck. From the storage tanks the odorant is run to a small day tank. Electric-motor-driven pulsafeeders or diaphragm pumps move it at a controlled rate through a flowrater and into the pipe line. The flowrater measures the flow and so verifies the rate of pumping. The odorant is dripped into the pipe line.

To control the rate of pumping a Pitot-Venturi element is installed upstream from the point of odorant injection. This element is connected through a pressure transmitter to the control mechanism of the pump. Variations in the gas flow rate effect a change in the pump linkage, causing it to pump proportionately more or less odorant into the gas. Odorant is supplied at a rate of 1 lb per million cu ft.

The odorizer will odorize the main line and a large lateral; so there is a pump and injection device for each of these. A third pump has been installed as a spare. Diaphragm pumps were selected because they eliminate the nuisance of odorant leakage around the packing.

A 14-ft × 16-ft building, plastered on the inside, will house the pumps, day tank, and controls. This will be purged by a building fan exhausting through activated carbon filters to clean the air so that the plant will not annoy the neighbors.

It is interesting to note that not all odorant problems require odorizing. One pipe line received gas with too much natural odor from an excessive amount of mercaptan. This was unsatisfactory from the customer's viewpoint and the pipe line was forced to remove it.

Hence even in the gas pipe-line business the customer is always right. In fact, he is the ultimate determining factor in how or why gas is conditioned. To conclude, then, whatever correction is made to the gas or however it is made, the final purpose is to give the customer an uninterrupted supply of gas—as cheaply as possible.

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GREAT buildings and expensive laboratories can never make a great university; great teachers do . . . Those who have taught for many years frequently observe advantages and limitations of various disciplines both in fact and in the hopes of opinionated partisans. But education is of a whole man for a whole world—humanities, urbanities, banalities. He who is either unable or unwilling to correlate phases of intellectual experience is likely to contribute little to education—of himself or of others. Hardy Cross in "Engineers and Ivory Towers."

Selecting and Training FORK-TRUCK OPERATORS[1]

By DONALD R. HOLM

HYSTER COMPANY, PORTLAND, ORE.

NEED FOR TRAINING PROGRAM

THE application of self-powered lift trucks to the materials-handling operations of industry and government is a comparatively recent innovation which had its impetus during World War II. Unfortunately, when the use of mechanized materials-handling equipment was employed to move the materials needed in modern warfare, the very factor that was responsible for the boom in the use of this equipment—lack of manpower—set a subsequent standard of indifference to efficient operation of this equipment.

At the time there was an acute shortage of qualified candidates to operate lift trucks. Operators were hired blindly and trained on the job, often not even being shown the control positions before being turned loose on a work force. Aside from the safety angle, these operators knew nothing whatever of basic principles of materials handling and the unit load, very little about preventive maintenance to keep their machines operative, and almost nothing about utilizing the lift truck to the fullest extent of its versatility and mobility.

Those plants and depots which did institute some sort of training program also did so almost desperately. Experience has shown that even in these early and haphazard training programs, less than 50 per cent of the graduates qualified as competent drivers.[2] Of those who did, around 15 per cent quit after being trained and placed on the job because of lack of interest or temperament.

Of course, experience is the best instructor—though the slowest and costliest—and out of all the mistakes and experiments in those days emerged some theories and concepts of what qualities are desirable in the selection and training of good operators; specifically, how to determine who has those qualities and logically how to make use of them.

In the years since the war operator training has had the time to catch up with technical developments. That it has not done so yet is due possibly to lack of clear-cut information on the subject and certain definite objectives. However, the important thing is that there is a growing realization of the necessity of a sound program for the selection and training of operators.

This was brought home to the author gradually, in the course of his normal work, by an increasing number of requests which were received for information on operator training. These requests came from Army and Navy depots, from industrial firms and warehouses, from supply officers, materials-handling consultants, maintenance engineers, efficiency experts, and servicemen.

We had nothing on the subject to offer and, in order to fill the requests, it was necessary to find material or sources of material to which those who desired information could be referred. In view of the obvious interest in the subject, it was amazing to discover there was nothing available that was thought to be worthy of passing on to the people who needed the information. So, in sort of desperation, the author attempted to prepare a training manual.

As a result of devoting the better part of two years collecting and developing training material, it was possible to arrive at some definite conclusions and to begin preparing a manual or booklet that would be suitable for use in answering requests.

The results of this study and effort are presented in the following.

OPERATOR IS IMPORTANT FACTOR

It has been observed that in spite of the engineering which goes into a lift truck, it is only as efficient as the man who operates the controls. He not only sets the pace of the machine, but the pace of the entire materials-handling operation. He is directly responsible for the safe and efficient handling of thousands of dollars worth of goods, as well as the safety of other men in the vicinity. He is also responsible for preventive maintenance of the machine itself. In fact, he is the brain that controls the entire business of moving materials mechanically.

If operators are not selected carefully, trained thoroughly, and adequately supervised, the entire potential value of the lift truck is affected. The basic purpose of operator training, aside from safety, is to develop a trainee into a skilled operator who thoroughly understands the principles of mechanical materials handling, who knows his machine inside and out, as well as how to manipulate it expertly. He should know how to obtain maximum performance out of his employer's investment with a minimum of wear and tear.

An extreme example of one company's lack of good materials-handling practice is evident in the following costs incurred by its fleet of lift trucks over a 20-month period:[3]

Damage to materials	$ 15,000
Injuries (including one fatality)	80,000
Vehicle damage	5,000
Damage to facilities	10,000
Total	$110,000

In other words, in less than two years this company suffered a cash loss of $110,000—the price of a fleet of about 35 brand-new lift trucks.

BASIC REQUIREMENTS OF GOOD PROGRAM

What then constitutes a good operator training program and what is its scope? It is believed to be a two-phased proposition involving both the "selection" of candidates and the "training" of these candidates. One is equally as important as the other.

As to scope, the actual training should include safety, basic materials-handling techniques, preventive maintenance, and of course, proper driving techniques. For the successful operation

[1] Portions of this paper were copyrighted in 1951 by the author.

[2] "A Selective Service," *The Palletizer*, vol. 3, February, 1946, pp. 2–5.

Contributed by the Materials Handling Division and presented at the Spring Meeting, Seattle, Wash., March 24–26, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[3] "Training Lift Truck Drivers," *Occupational Hazards*, vol. 13, 1950, p. 23.

of such a training school, a classroom is needed, as well as a practice court and practice machines, and necessary training tools, including a good curriculum. Instructors should be qualified supervisors, a definite time should be set aside for the school, and suitable award of completion should be furnished successful candidates—this latter logically could take the form of an operating permit.

SELECTION OF CANDIDATES

The selection of candidates is not so difficult a problem because there are established standards already in existence and many of the larger companies have facilities for the routine testing and interviewing of applicants for certain types of skills in their personnel setup. Many of the tests and standards developed for the selection of road-truck drivers and other types of machine operators are suitable for lift-truck-operator candidates.

Logically, most of the accepted physical and mental standards for lift-truck operators today are the outgrowth of studies made in accident cases by such organizations as the National Safety Council and the American Automobile Association. Safety as a big factor in setting up physical and mental standards is officially recognized by the Society in the following:

"Only trained operators shall be permitted to operate an industrial power truck. Methods shall be devised to train operators in the safe operation of industrial power trucks as prescribed by this code."[4]

"Industrial power trucks shall be operated only by authorized operators."[5]

The selection of operator candidates should begin in the first interview with the prospective employee in the personnel office. In addition to the routine information required of the applicant, the interviewer should obtain, if possible, the applicant's past experience and safety record in the operation of highway and other motor vehicles.

General intelligence and mechanical aptitude tests, which indicate the applicant's good judgment, ability to learn, aptitude, alertness, and personal attitude, should be given. General physical requirements usually provide for amputees and similarly handicapped persons as long as their physical disability can be compensated. Periodic physical examinations, even after the applicant is hired, should be the rule in order to maintain the standards adopted.

VISION MOST IMPORTANT

One of the first and most important requirements which resulted from early studies of the problem is that of good eyesight. Though the various standards now in practice differ somewhat on the requirements of good eyesight, they all agree that it is most important.

The ASME Code recommends that operators of industrial power trucks not only be physically qualified by an examining physician, but also that the applicant's visual acuity without glasses or properly compensated with glasses, shall be "at least 20/40 in one eye, and 20/100 in the other eye; form field should not be less than 45 deg in all meridians from the point of fixation; ability to distinguish red, green, and yellow shall be required."

Minimum standards used in the Keystone "Telebinocular Visual Safety" test[6] are:

Without Glasses. Each eye shall have acuity of not less than 20/45; or binocular vision, i.e., both eyes used together, shall not be less than 20/33 with neither eye less than 20/60.

With Glasses (Corrected). Each eye shall have acuity of not less than 20/33; or binocular vision must not be less than 20/33; with neither eye less than 20/45.

Depth Perception. Depth perception, with or without glasses, shall not be less than 20/45. The field of vision shall not be less than 190 deg, with not less than 80 deg in each eye.

The U. S. Civil Service Commission, recognizing that operators are subjected to arduous physical exertion and constant jolting and vibration, has set up the following physical standards:

Eyesight. Good vision is required. Defective vision allowed is corrected to 20/30 in one eye and 20/50 in the other. Good depth perception. The Army, in addition, recommends sufficient side vision (preferably 90 deg minimum) to enable the operator to see objects on either side while looking straight ahead, and sufficient color vision to be able to recognize red and green.

Hearing. Defective hearing allowed, with or without a hearing aid, if acute for ordinary conversation.

Heart and Blood Pressure. Moderate hypertension permissible; organic heart disease allowed, if fully compensated.

Emotional and Mental Stability. Fully essential.

Other Deficiencies Acceptable. Arrested or healed pulmonary tuberculosis; deformity or disability of hip, shoulders, or fingers (one hand); amputation of fingers (one hand).

In addition, operators usually are required to undergo periodic checkups at the time of permit or license renewal, after each accident, injury, or extended illness, or at other times deemed necessary to insure that the operators are physically qualified to drive materials-handling equipment.

AAA TESTS

The standards and testing devices of the American Automobile Association are commonly used today in the selection of fork-lift-truck operators. Though devised primarily for the testing of automobile drivers, these have worked out very well in most instances with fork-truck and tractor operators.

The AAA tests include field of vision, activity, steadiness, strength of grip, foot reaction, and hearing. Steadiness is tested by having the applicant move a stylus downward between two graduated metal strips set in the form of an elongated V. When contact is made a light flashes. In three tries the applicant must average a score of eight to pass with a grade of C.

In the grip test, the applicant must rate 50 kg measured on the hand dynamometer for a passing grade of C. The applicant is allowed two trials with each hand and is credited with the highest score.

Activity is gaged by a meter recording the number of hand movements or "taps" which an operator can make during an automatically timed 10-sec period. Sixty-eight taps are required for a passing grade. This test reveals the driver's ability to act quickly in an emergency.

A method of testing hearing is with a 3-in-diameter tube having four openings along its length and being open on one end. The open end is placed next to the applicant's ear and a stop watch is moved to the various openings. A person who can hear the tick at the farthest opening, 50 in. away, has normal hearing, and receives grade A. For a passing grade the applicant must be able to hear the watch at the second opening, or 20 in. away.

The AAA foot-reaction tester measures the time required for an operator to move his right foot from the gas pedal to the brake when a green light changes to red. The reaction interval is measured in fractions of a second on a scale in the rear of the testing device. A passing grade requires that the individual apply the brake in less than a half second.

A typical experiment conducted with a group of untrained or

[4] "Safety Code for Industrial Power Trucks," ASME, ASA B56.1-1950, part 2, p. 25; section 7, "General Safety Regulations," article 702.
[5] Ibid., article 703.
[6] Keystone View Company, Meadville, Pa.

untested operators of all types and sexes turned up some interesting facts. Of this group of 200 a study of the scores showed that 14 per cent had grades of 29 or less, while the average was 30.7 per cent. Thirty was selected as the lowest acceptable score for a candidate. Of the 37 per cent who had a score of 59 or less, analysis showed that this group consisted of those operators who were responsible for most of the accidents, or those who had physical or other defects. The study showed also that the most desirable operators had a total score of 60 or better, which was subsequently adopted as the minimum requirement for new operators in this plant.[2]

Other tests in use include Scott's "Mental Alertness Test" and the Stenquist "Mechanical Aptitude Test No. 1." Scott's test is based on arithmetical reasoning, quickness and accuracy of judgment, clearness of perception, degree of comprehension, and the ability to follow instructions. It does not depend upon formal schooling of the candidate and does not call for knowledge of an unusual nature.

The Stenquist test determines if the candidate has either mechanical experience or native ability in mechanical matters.

It is important that the results of such comprehensive examination of candidates should be determined before the candidate is admitted to an operator training program. This assures a selection of trainees who are the most likely to become good operators, and those who will absorb better the training given them. Slow and inept candidate trainees should not be allowed to waste the time of instructors and training equipment.

Of those who do pass, one can be reasonably sure that the results of the next step in the program—operator training—will more than pay for the entire selection and training program in increased efficiency and safety.

TRAINING OPERATORS

As to setting up an actual training course for prospective operators, it is up to the employer, himself, to evaluate the costs against the expected results. Many firms are finding out, however, that it is just good business to invest 5 or 10 days of a new employee's time in comprehensive training that will assure a profitable return weeks or months sooner than unorganized on-the-job training.

Usually the lift-truck operator, himself, especially the new hand, welcomes such training because it assures him of an initial degree of skill before he is turned loose among the older hands. The confidence that comes from thorough training and preparation is well worth the time and effort to acquire it.

Realizing that there are innumerable obstacles in the way of installing an operator training school in the average industrial plant or supply depot, the author has tried to take cognizance of the main objections to such a program in preparing a curriculum and outlining a physical setup to fit most needs. A principal factor is the work-time involved. How much time could the company profitably invest in a specialized training course for the new employee? It is believed that the first month or two of a new employee's time is unprofitable in any case and it was for this reason that the curriculum was designed especially for the new employee. At the same time such a curriculum must be flexible enough to accommodate old hands whom the company could profitably re-educate. This also was taken into account.

The end result was an intensified curriculum to run 5 days (in order to dovetail conveniently into the usual work week) and designed thoroughly to acquaint the trainee with the fundamentals not only of safe and efficient lift-truck operation, but also the fundamentals of preventive maintenance and materials-handling methods. An outline of the curriculum is given in the appendix. The course, which is the basis for the operator training school, is designed for flexibility of operation and to supplement classroom training with actual practice.

If an organized materials-handling department does not exist, this training program can be carried on easily by the safety, personnel, traffic, or even the maintenance department of the firm. The main thing is that it should be organized and operated specifically as an operator training course. In addition to the new candidates (who have been selected as operator-trainees by some intelligent means of interviewing, testing, and eliminating those least likely to make successful drivers), every member of the plant's materials-handling setup, especially including supervisors and veteran drivers, should be put through it.

CONDUCTING THE FIVE-DAY SCHOOL

The school should occupy separate quarters from the rest of the plant's activities. An unused storeroom, conference room, or large office would be suitable. It should be as close as possible to the practice area. The instructor or instructors should be full-time personnel, preferably supervisors, trained in the job of instructing. (Unless the turnover is large, the school need be activated only periodically such as once a month, or once every 6 months.)

Teaching aids should stress oral, visual, and manual types of instruction, and such props as are necessary should be prepared and tested in advance. A suggested list of props is given in Table 1. The course should be conducted on the principles of tell, show, practice, correct.

TABLE 1 SUGGESTED PROPS

Classroom		
Conference tables	Model lift trucks	Scoring sheets
Chairs	Sample pallets	Available literature on subject
Blackboard	Truck parts	Prepared quizzes
Cartoon posters	Mock-up or actual truck	Graduation certificates or operator permits
Slides	Prepared lectures	
Movies	Giveaways	
Practice Area		
(A paved area at least 50 ft × 50 ft, either indoors or out)	Boxes	One or more lift trucks and attachments
48-in. wood pallets	Crates	Skids
Empty barrels	Bagged material	Chalk for lines
Drums		

Classes should consist of not more than five trainees, and each day's session should be divided between classroom work and practical instruction with the machines in the practice area. The five-day curriculum is flexible enough so that it is possible to intermingle classroom work with practice or to divide up the two types of instruction according to individual circumstances. A part of the session should consist of forum type of instruction with each candidate taking an active part in his own criticism and instruction. Quizzes should be given covering each day's work, graded, and suggestions for improvement made. Each trainee should have a record card showing the day's progress and his personal weak points. Effort should be made to eliminate those weak points before going on to the next step. The final examination should take the form of qualification tests and should demonstrate the operator's skill of handling the truck, his judgment, knowledge of safety, basic materials handling, and preventive maintenance. A certificate of graduation should be issued upon successful completion of the course and this could take the form of an official operator's permit.[7]

[7] Good examples of classroom quizzes and "giveaways" can be found in "A Training Program for Fork Truck Operators," part 1 and part 2, *Modern Materials Handling*, vol. 6, September and October, 1951.

TABLE 2 OUTLINE OF FIVE-DAY CURRICULUM

PART I—(Classroom)	PART II—(Practice Court)
FIRST DAY	
1 Introduction (a) Reason for program (b) Benefits of program (c) Outline of course 2 Basic Instruction (a) Safety (b) Engineering principle of lift truck (c) Nomenclature of parts (d) Description of machine (e) How to start, stop, and turn	1 Basic Instruction (a) Demonstrate controls (b) Demonstrate forward movement (unloaded) (c) Demonstrate reverse movement (unloaded) (d) Demonstrate turning (unloaded) 2 Practice Session (a) No obstacles
SECOND DAY	
1 Quiz (a) Cover lessons of previous day 2 Safety (a) Do's and don't's 3 Preventive Maintenance (a) Operator's responsibility (b) Basic Service Requirements 4 Basic Instruction (review) (a) Starting and stopping (unloaded) (b) Forward movement (unloaded) (c) Reverse movement (unloaded) (d) Turning (unloaded)	1 Preventive Maintenance (a) Demonstrate inspection (b) Demonstrate service points 2 Basic Instruction (a) Practice forward movement (unloaded) (b) Practice reverse movement (unloaded) (c) Practice turns (unloaded) 3 General Techniques (a) Demonstrate operation for hoisting, lowering, tilting forks (unloaded) 4 Practice Session (a) Obstacle course (forward, reverse, turning) (b) Operation of forks
THIRD DAY	
1 Quiz (a) Cover lessons of 2nd day 2 Safety (a) Do's and don't's 3 Preventive Maintenance (a) Review (b) New material 4 Basic Instruction (a) Starting and stopping (loaded) (b) Forward movement (loaded) (c) Reverse movement (loaded) (d) Turning (loaded) 5 General Operating Techniques (a) Operating forks (loaded) (b) Maneuvering (unloaded)	1 Preventive Maintenance (a) Review by actual demonstration 2 Basic Instruction (a) Practice forward movement (loaded) (b) Practice reverse (loaded) (c) Practice turns (loaded) (d) Practice operation forks (unloaded) 3 General Techniques (a) Operating forks (loaded) (b) Maneuvering (unloaded) 4 Practice Session (a) Obstacle course
FOURTH DAY	
1 Quiz (a) Cover lessons of 3rd day 2 Basic Materials-Handling Techniques (a) Types of pallets (b) Methods of loading pallets (c) Aisle widths (d) Floor loading 3 Safety (a) Do's and don't's 4 Preventive Maintenance (a) Review of all material previous 5 Basic Instruction (a) Operating forks (loaded) (b) Maneuvering (unloaded) 6 General Operating Techniques (a) Basic maneuvers (loaded) (b) Advanced maneuvering (unloaded)	1 Basic Instruction (a) Practice maneuvers (unloaded) (b) Practice operating forks (loaded) 2 General Techniques (a) Demonstrate advance maneuvers (unloaded) (b) Demonstrate operating under adverse conditions (unloaded) (c) Demonstrate attachments (optional) 3 Practice Session (a) Obstacle course
FIFTH DAY	
1 Quiz (a) Covers lessons of 4th day 2 Basic Materials Handling (a) Review of previous material 3 Basic Instruction (a) Review of maneuvering (unloaded) (b) Maneuvering (loaded) 4 General Operating Techniques (a) Advanced maneuvers (loaded) (b) Review of advanced maneuvering (unloaded) (c) Review of operating under adverse conditions (d) Operating under adverse conditions (loaded) (e) Review of attachments	1 Basic Instruction (a) Review maneuvering (loaded) (b) Review of operating adverse conditions (unloaded) 2 General Techniques (a) Review of adverse maneuvering (loaded) (b) Demonstrate operating under adverse conditions (loaded) (c) Review of attachments 3 Practice Session (a) Obstacle course (b) Qualification tests
SUPPLEMENTARY	
I Presentation of certificate of eligibility (Operating Permit) II Lift-truck rodeo III Periodic qualification tests IV Operating manual for eligible operators	

Referring to the outline in Table 2, it will be noted that the curriculum is divided into two phases—classroom work and practice court—and that it is flexible enough so that these two phases of instruction can be divided equally, run concurrently, or alternated, depending upon individual conditions. Yet this 5-day curriculum is thorough enough, it is believed, to turn out qualified operators.

Take, for example, the first day's session. The column on the left outlines the classroom subjects and the column on the right the practice-court activities. The time spent on the practice court is to be used to demonstrate by actual practice what has been discussed in the classroom. The two phases of each day's instruction can be alternated throughout the day's session (for example, a problem can be discussed in classroom, after which the class goes out into the practice court for an actual demonstration); or the classroom work can occupy one part of the day and the practice session the other.

Classroom instruction should make liberal use of props such as lift-truck models, slides, movies, and "giveaways" (listed in Table 1). On the practice court all that is needed is a truck or two with which to practice, and a supply of pallets, boxes, and dummy loads. Enough pallets should be on hand to use in setting up obstacle courses. This is done simply by standing the pallets on end in an arrangement designed to give the

trainees practice in performing the various maneuvers, such as negotiating narrow aisles, making sharp turns, and approaching stacks with loads.

By the fifth day's session the trainee should be ready for a thorough review of everything learned thus far. At this time the student has been exposed to all the basic material necessary in becoming a skilled operator. He also has had several hours of individual practice as well as observation of the skill of other drivers. He is acquainted with basic materials-handling techniques, rules of safety, and methods of preventive maintenance.

On the practice court all the maneuvers learned thus far should be reviewed and practiced individually. The student at this time should be in possession of the rudiments of all lift-truck maneuvers and should have had some practice in each.

The last hour or so of the fifth day's session could be taken up with qualification tests, which the trainee must pass, although this could be reserved for a special occasion, such as a "lift-truck rodeo." Certificate of eligibility may take the form of an official operator's permit, which of course should be subject to future re-examination.

In addition to this 5-day schedule, successful candidates could be given an operating manual to keep in their possession, and periodic qualification tests should be given every lift-truck operator. An event which is gaining in popularity among owners of lift trucks, especially in large operations, is the lift-truck "rodeo," which is a competitive event staged among the operators to demonstrate skill, usually with awards for the best performances. Such an event also could be worth while from the standpoint of public relations and employee morale.

FROM A PRACTICAL STANDPOINT

In devising this 5-day course no attempt was made to lay down a set of arbitrary rules. If nothing else could be concluded from research on the subject, it is that individual circumstances from plant to plant vary so greatly, and the problems are so numerous that such training classes must almost be "tailor-made" to suit conditions. In the first place there are dozens of different makes of lift trucks in use today, some are powered by gasoline, some by electricity, a few by liquefied petroleum gas; some have automatic transmissions, others have manually operated gears; some operations require lift trucks only a small part of the time, others depend entirely upon lift-truck operation; and finally, the capacity range of the various lift trucks starts at about 1000 lb and graduates up to as high as 24,000 lb—although the bulk of the machine population falls in the 2000- to 4000-lb class.

Another factor which must be considered is that the firms which employ only one or two lift trucks far outnumber the large companies which operate entire fleets. Obviously, it is impractical for an owner of less than five or six lift trucks to go to the expense of setting up an operator training school, even periodically.

A solution might be, however, for a group of small owners in an industrial area to pool their resources and set up a central training school, each company contributing according to the relative number of operators it wants trained. Similar classes for instruction in lift-truck maintenance are already in existence.

There is no doubt whatever, though, that the need for operator training is becoming critical. This fact is evidenced by the greatly increased interest in, and attention to, operator training. Every possible effort should be made by lift-truck owners to utilize to the fullest extent the engineering and versatility that is built into the materials-handling equipment now available, to keep these machines operative at minimum maintenance cost and minimum loss from accident. Therefore it is manifestly important to spend whatever time and effort are practical upon the training of the man who operates the machines—in other words, upon the brain that controls the operation.

How important the lift truck is to the operation was brought home to the author by talking with the operations manager of a large progressive West Coast motor freight line in the course of his research. In each of its terminals this freight line uses from one to five lift trucks. Although this man did not think it practical, because of his peculiar type of operation, to institute a formal training program, nevertheless a good deal of attention is paid to selecting the proper type of operator (operators are given the regular road truck-driver tests) and seeing to it that he was "broken in" right. This even extends to the psychological aspects. On one visit to the Seattle terminal the operations manager discovered that the men referred to the lift trucks as "bulls." He was horrified because he felt that such a nickname would create the impression that the lift trucks were instruments with the same purpose as bulldozers. He went so far as to issue an official order prohibiting this term from being used in reference to the lift trucks.

But whether a firm owns one lift truck or two dozen or more, the materials-handling operation will not be conducted to the fullest extent of its efficiency unless the operator understands the fundaments of safe operation, preventive maintenance, and materials handling, as well as the best techniques of lift-truck handling.

The surest way, and in the end the most economical way, to achieve such operator perfection lies in the scientific selection and intelligent training of the operator candidates before they are permitted to operate.

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DURING recent years the possibility of a kind (or kinds) of clock entirely different from any hitherto known has come to light. It has now proved to be possible to count the vibrations of the molecules of ammonia gas under electrical excitation for a short time. Presumably these vibrations have a high degree of independence of the motions of celestial bodies. Presumably also they can be relied upon to have a high degree of invariability, and hence in principle they should provide a very good clock. The models so far constructed have not kept time quite so accurately as the quartz clocks, but it seems to be possible to refine them considerably. The difficulties, which are very real, are difficulties of engineering, not of principle. Such clocks, even if they ran only a few seconds without stopping, might be used as new standards of frequency. There is no likelihood that one will ever be adopted as a fundamental standard of time itself, because no man-made machine can be as reliably continuous in operation as the celestial bodies are. It would, however, be of the greatest interest to compare the running of such a clock with the sidereal year. Should we find the two kinds of time to be compatible, or would one be continuously accelerated with respect to the other? The answer to this question would reach to the foundations of physical science. G. M. Clemence, *American Scientist*, April, 1952, pp. 260–269.

INCENTIVES *for Better* PRODUCTION EFFECTIVENESS

By PHIL CARROLL

CONSULTING INDUSTRIAL ENGINEER, MAPLEWOOD, N. J. FELLOW, ASME

WE all agree that productivity is what has made America great. We know too that productivity is the reason why our standard of living is the highest in the world today. Also those in management are fully aware of the fact that our productivity is not an accident. It was caused.

Many factors have contributed to the result. Eli Whitney established the principle of interchangeable parts. Carl Johansson gave us the standardized "inch" so we could make pieces that would go together. Henry Ford pushed ahead the conveyer method and evolved mass production. And we must emphasize, too, the enormous investments in tools that permit the applications of these principles. Then Taylor and the Gilbreths added time-and-motion study. These enabled us to multiply the applications. But all these are methods, or techniques if you prefer.

They become "productivity" only through people. People run machines and turn out pieces. People increase productivity and restrict it according to their attitudes on the job. One of the important influences with people is what we call wage incentives.

SKILL AND ABILITY

One English author calls wage incentive "payments by results." But I think there is more to incentives than that. For example, the element of pride of accomplishment cannot be overlooked. People like to excel. They want to know how they compare with others. And according to the experts, people like to work when they know what they are supposed to do and get credit for doing it.

Well, under good wage incentive people get measurement of their work performances. They know where they stand relative to the others. Such measures are objective as we say, and can be used constructively in any form of merit rating.

Skillfully used, such performance measures have many applications. Let me indicate a few. Take the premise that "promotions should be made from within." How better can we up-grade and watch the progress of the advanced person, and his successor, than by some measure of applied skill and ability? Take the dictum, "We should try to put the round man in the round job." How do we know when we have succeeded? Yes, I know that proper training is an important half of proper performance. But how do we know whether or not a person is trained? Then there is the commonplace slogan, "a fair day's pay for a fair day's work." How much is a fair day's output? What measure do we have? These and many other questions are better answered when we utilize sound work measurement.

INCREASED EARNINGS

People work for recognition, for status and to "get ahead," as we express it. At the same time they say, "a title without a raise doesn't buy the baby any shoes." So we have to think of the money rewards. Put another way, work measurement without wage incentive is restrictive. With so-called "measured day-work," we, in effect, say, "You can't do any more than a standard day's work because we won't pay you any more." And under the present labor laws, we cannot utilize wage incentive without the approval of the unions.

"Measured day-work" is negative, also. It says in principle, "You are subject to criticism or to discipline if you do not turn out the standard production." And the psychologists tell us that the negative approach is not nearly so productive as the positive. Hence, I believe strongly in extra earnings for extra production. I advocate the use of one-for-one payments for output in excess of standard amounts.

This is very important from the standpoint of better production effectiveness. It amounts roughly to 25 per cent more output, if we assume an increase equal only to the difference between standard and normal incentive performances. But the increase is actually greater. Productivity under measured day-work rarely comes up to standard except on paced operations. And without standards, the output may be at any rate down to 50 per cent or less.

The important point is that people want to earn more. Our appetites for things are insatiable. Our families have wants that would make a list as long as our arm. We have a feeling that we are "getting some place" when the pay check increases. We even fall into the trap of thinking that life is rosier with a nearly doubled bank roll of 57-cent dollars. Nevertheless, people do respond to money incentives. And the conservative 25 per cent increase in productivity mentioned is a lot of output in anybody's plant.

Look at it in terms of plant investment. If we take the $10,000 average cost to provide one job, this increase would be equivalent to $250,000 for a 100-man plant. And I understand that 86 per cent of our plants are that size or smaller.

Think of the money earnings. An increase of 25 per cent is about equal to four rounds of a dime each, and there is no inflation resulting. Wage incentives provide the only way I know for employees, managements, investors, and consumers to gain by the increases in earnings.

INDIRECT LABOR

Now, I disagree emphatically with our limited applications of incentives. Why is it that we measure only the repetitive jobs? Why do we overlook the indirect and the overhead operations? In our shortsightedness, we create an earning discrimination. We provide increased earning opportunities for some and not for others. One result is that some nonincentive people are given unearned wage supplements. This destroys incentive. To illustrate, take a $1.00 base rate for easy arithmetic. If we give a 10-cent supplement to a $1.00-an-hour base, there remains only a 15-cent differential from the $1.25 incentive earning on a $1.00 base. But incentive is now but 13.6 per cent. That is not enough, in my experience.

If incentive is good for some, it is good for all. And this is true even if we restrict our thinking to our subject of "better production effectiveness." Production is what we turn out

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with a given capacity and manpower. Effectiveness has to do with the rate or the production per man-hour. But we are talking about product or salable pieces. We are confining our analysis to supplying our customers. Here is one reason why we set standards generally for productive labor operations, as we call them.

We neglect the indirect work because pieces are not produced by overhead people. But these folks turn out a kind of production. In part, it is like one speaker said during the war, "Believe it or not, we have production in Washington. It is waste paper."

OVERHEAD PRODUCTIVITY

We don't know how much of our overhead labor is given to waste paper, so to speak. We haven't studied it, as we would have to if it were on sound incentives. Sure, I know that incentives will not eliminate wasted work. Often, we have incentives and good performances on direct labor operation that we shouldn't do at all. But overhead operations are not nearly so well controlled. We can wear out pieces by inspecting them repeatedly. We can repair equipment until it is worth its weight in gold. We can carry our cost systems to four decimal places and produce interminable reports that nobody looks at. Why?

I think these things go on because we have not applied incentives to the work. To move in this direction, we would think first of the microscopes of time-and-motion study—work analysis. These, in themselves, reduce wasted effort but not wasted work. We approach the effectiveness of elimination by cost analysis. We ask, "What is the value of this operation in terms of what we spend." To me, that is the constructive way to improve effectiveness.

OVERHEAD COST

We do not know our overhead costs. We go through the motions of spreading it on with a shovel. As a result, we produce certain items repeatedly at a loss. That is one point. The more important one is that our overhead climbs with every improvement we make in the shop. So that, every day we put off the study of indirect costs and the application of incentives, the less becomes our over-all manpower effectiveness.

SUGGESTED IMPROVEMENTS

Whether we look at indirect or direct operations, we must consider the incentives in suggestion awards. These are very worth while in our effortst o better production effectiveness. These can help to uncover the veritable gold mines buried in our plants and offices.

Suggestions help to attain our objective in two ways. One is the obvious improvement in productivity. The other is the likelihood of strengthening the feeling of participation. Remember, this thing called Yankee ingenuity. Few of us are Yankees, I concede. Yet the creative urge is present. We all like to think up better gadgets. We have a lot of mechanical sense. What do we offer as constructive outlets for these latent abilities? Very little, if my observations are a fair sample.

We should make use of incentives to reduce wasted efforts in seeking suggestions for method improvements. We should pay awards that will arouse interest. We should publicize the names of those who contribute ideas. We know that seeing our names in the news is worth more to some people than money. And we don't have to pay income tax on it. Then, we should get the suggested improvements into actual operation. We are aware that many have their incentives in seeing their own ideas put into effect.

These three different incentives do appeal to people regardless of their places in industry. I want to emphasize that point. To illustrate, I am dead set against the restriction that foremen cannot make suggestions. I object to the notion that a foreman's salary includes payment for methods improvements. If we said that we had different suggestion plans for the foreman from the ones arranged for the man on the bench, that would be the right answer. We should not disqualify those in the organization who are supposed to work with their minds.

INCENTIVES FOR ALL

Again, I say that if incentives are good for some, they are good for all. We need more incentives to bring out the best in people. We should take positive action to offset the trends toward leveling everybody to a common standard. Where will our future leaders come from if it isn't worth while to step out of line? Paying more money for the same performances won't do it.

We pound on the theme of better industrial relations at every conference. We repeatedly hear that we have neglected the human element in our zest for mechanization. Probably, much of this is correct advice. Also, I think we must recognize the differences in people that are emphasized in all of these admonitions.

But I ask, "Why should a man serve an apprenticeship to become a toolmaker if he can't earn any more than a drill-press operator working on incentive? How can you get a man to take a promotion to foremanship if he loses money in the deal? How come a vice-president may decline a much bigger job at a substantial increase in salary that he can keep but a fraction of?" These are isolated instances. Their basic causes are distinctly different. Yet, all stem from lack of incentive.

We are going downhill when men decline to be their best. We are losing the advantages of super skills. We are failing to develop the abilities of people when, in effect, we say, "There's nothing in it for you." We contradict our progressive schooling methods when we fix earnings so that the best make very little more than the mediocre.

Obviously, the usual wage incentives cannot solve many of the problems my questions raise. But, they can help. The advantages lie more in the intentions to stimulate better performances than in the extra earnings paid. Just the same, the substantial increases in earnings made possible are important, tangible evidences of accomplishment. We should make the most of both. We need more and better incentives to develop the higher skills in people. We must remember that industry pays all the bills and so should use incentives for better production effectiveness.

COMPLETION of construction of the Cosmotron, a giant atomic accelerator, now undergoing testing and evaluation at Brookhaven National Laboratory, Upton, N. Y., was announced recently.

In announcing completion of the construction phase of the Cosmotron, Dr. Leland J. Haworth, director of the laboratory, said that all of the components have been tested separately, and have performed satisfactorily. However, he added, with high-energy accelerators, such a tune-up period often requires months before a beam of protons of intended energy is available for research purposes.

The Cosmotron is designed to speed protons to an energy exceeding 2 billion electron volts, or five times that of the most powerful existing accelerators. These protons (nuclei of hydrogen atoms) will strike various targets, including copper and hydrogen. Collisions at such energies are expected to produce mesons, the newly found array of short-lived particles which appear in cosmic rays and seem to hold the key to nuclear forces.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr. *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Nuclear Energy

Nuclear-Power Production

THE Atomic Energy Commission has begun negotiations with Dow Chemical Company and The Detroit Edison Company on their proposal to continue for one year, on a jointly financed basis, the Dow-Detroit Edison study of greater industrial participation in the development of nuclear reactors for the production of fissionable materials and power. The work proposed by Dow-Detroit Edison is in line with the AEC reactor-development program.

The Dow-Detroit Edison group is one of the four pairs of industrial and power firms participating in preliminary studies as a part of the industrial participation plan first recommended by Dr. Charles A. Thomas of Monsanto Chemical Company. Other groups are Monsanto and Union Electric of St. Louis; Commonwealth Edison and Public Service of Northern Illinois, Chicago; and Pacific Gas and Electric and the Bechtel Corporation of San Francisco.

The two companies have estimated their cost of the extended studies at about $250,000. Work to be done by the Commission in this area of research, much of which is already under way or scheduled, may run as high as $750,000. The Commission's action does not constitute a selection among the four. Full consideration will be given to the other proposals as soon as the sponsoring companies submit reports for action by the Commission.

All four teams have submitted interim reports which show a cautious optimism that the difficult technical and cost factors involved will be solved eventually. The Dow-Detroit Edison group is the first to lay before the AEC a specific proposal for going to the next stage—which will include additional research and development work by both the companies and AEC laboratories. The study will involve both reactors and chemical separation processes, but will not provide a final reactor design.

The other teams, as well as Dow-Detroit Edison, are studying several general types of reactors and may submit specific proposals later in the year.

Atomic-Energy Declassification

The governments of the United States, the United Kingdom, and Canada have revised the "Declassification Guide" used by the three nations to determine what atomic-energy information held jointly may be published and what information should remain under secrecy.

The revisions are based on the recommendations made by the Fifth International Declassification Conference held Sept. 14–16, 1951, in Washington, D. C., as a continuation of the wartime collaboration of the three nations. The principal revisions to the Declassification Guide will permit the release of additional data on the nuclear properties of uranium, data necessary in the development and understanding of low-power nuclear reactors for atomic research. To speed the development of unclassified reactor technology in the three nations, design and operating data on such reactors was previously declassified in November, 1950. The current action will make available to universities and laboratories engaged in unclassified research with nuclear reactors further data that will advance their studies. The three governments have determined that the release of this technical information will assist the expanding manpower training program involved in the atomic-energy efforts of the three nations, and will not aid rival nations in the development of military application of atomic energy. Low-power natural-uranium research reactors cannot be used for production of atomic weapons or power.

The revised Declassification Guide permits publication of the thermal neutron cross sections for Plutonium-239. Plutonium, basic nuclear-reactor fuel, is a fissionable material from which atomic energy can be derived. Its properties with respect to capture and fission by thermal neutrons are similar to the properties of Uranium-235. However, when Plutonium-239 fissions from the action of thermal neutrons, it is now revealed that three neutrons are released per fission rather than the 2.5 neutrons released by Uranium-235 under similar conditions.

In addition to releasing further information on the low-power research reactors, the revised Declassification Guide permits the publication of the thermal neutron cross section of Xenon-

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

135. This radioactive nucleus, one of the fission products resulting from the fissioning of uranium, is a remarkably effective absorber of thermal neutrons. The release of specific technical information on this property of Xenon-135 will be of basic scientific interest in studies of nuclear structure and will aid in fundamental studies of reactor control.

Low-Intensity Test Reactor

A new nuclear reactor of advanced design has been put into operation by the Oak Ridge National Laboratory, at Oak Ridge, Tenn.

The new reactor, known as the low-intensity test reactor (LITR) is being used to make high-priority tests of radiation effects on certain construction materials of possible use in future nuclear reactors. It will also produce limited quantities of rare radioisotopes such as chromium-51.

The LITR "went critical" early in the spring of 1950 as a nuclear mock-up of the materials-testing reactor (MTR) now in operation at the AEC's national reactor testing station, Arco, Idaho. It was then improved to operate at a higher power, and in the spring of 1951 was put into service for training MTR operators. Research facilities were added and the power further increased in the fall of 1951.

The LITR was designed and constructed by Oak Ridge National Laboratory, operated for the AEC by Carbide and Carbon Chemicals Company, a division of Union Carbide and Carbon Corporation. Its total cost was approximately $1 million.

The primary use of the LITR will be to assist engineers and scientists in learning more about how materials proposed for use in atomic furnaces of the future will stand up under the bombardment of neutrons—the nuclear particles that are the key to atomic fission. Since the LITR can produce both fast and slow neutrons at varying intensities, it is expected to be extremely useful in testing such materials.

The reactor itself is about $2^1/_2$ stories high. It uses ordinary water as a coolant and uranium enriched in U-235 as fuel. Because of its advanced design, the structure of its core and its fuel arrangement remain classified.

Reinforced Plastics

BECAUSE of the combination in reinforced plastics of unique properties, such as high electrical resistivity, magnetic permeability of unity, physical strength, low weight, corrosion resistance, ease of fabrication in large complex shapes, and the use of less critical materials than metals in their formation, the U. S. Naval Ordnance Laboratory, at White Oak, Md., is studying and extending the use of reinforced plastics in housings for weapons and other ordnance devices, according to the NOL *Report* for April, 1952.

The valuable properties of the reinforced plastics or laminates are the result of the combination of relatively weak resins with high-strength reinforcements such as paper, cotton duck, nylon cloth, unwoven glass yarns, or woven glass cloth. The highest strengths per unit weight are obtained with glass-fiber reinforcements because of the exceptional strength of fine-spun glass fibers. In much of NOL's work, glass-cloth-reinforced plastics are being utilized for ordnance components, although for tubing a reinforcement of glass filaments or yarns wound in place shows promise.

In NOL's Plastics Branch, engineers study the problems associated with the design and construction of reinforced plastic structures, measure the properties of the materials under service conditions for design and specification purposes, develop improved resins, reinforcements, fabrication processes and techniques, produce models and large prototypes for design testing, and advise others on the technical phases of the subsequent commercial development or production.

Molding techniques utilized in forming complex shapes are similar to those used by the plastics industry. A mold is first produced which will give the size and shape of piece desired. Since NOL is interested in only a limited number of prototypes for test purposes, the mold is generally of a temporary low-cost type rather than the permanent steel tooling which would be used by industry for volume production. Woven glass cloth is cut to a pattern and tailored to the inside surface of the mold until the quantity and distribution of reinforcement are that required to give the desired strength. The halves of the mold are then closed and the laminating resin introduced into the lay-up by drawing it into the mold by means of a vacuum. After cure of the resin the piece is removed from the mold and machined as required.

Tooling for tube rolling is simpler than that for molding complex shapes. Only a mandrel, sized to give the proper inside dimension of the tube, is required. The tube is formed by winding resin-impregnated glass cloth onto the mandrel to the desired thickness and then curing the resin. The cloth is impregnated by pulling it through a resin pan and between rolls which squeeze the air from the weave and allow it to be replaced by resin.

Panel making is probably the easiest molding operation to perform, although the molding presses with their controls may be complex. Sheets of fabric are cut to size and resin is poured over each sheet as the lay up is made. The lay up is then covered with cellophane and rolled to squeeze out excess resin and to free the lay up of air. It is next placed in a press and the resin cured with the time, temperature, and pressure controlled.

Assembly of components is the final operation in the fabrication of a plastic ordnance item. Each component is machined to dimensions and bond areas are provided for assembling the pieces in their proper relationships. The bond areas are cleaned with solvents and coated with adhesive. The components are then mated together and held under pressure while the adhesive is heat-cured. Units thus assembled are ready for the tests by NOL engineers which determine the suitability of the reinforced plastics structure and point out any design changes required.

Elsewhere within the military establishment, glass-cloth-reinforced plastics have found use as piping aboard ship, as construction materials for Army assault boats and Navy whaleboats, as materials for Army water tanks, as radome fabrication materials, and as ductwork on aircraft.

The future of reinforced plastics for Naval Ordnance use is rapidly becoming of prime importance. In the Plastics Branch, such applications are being studied from the conception to the prototype stage forming one of the Branch's major functions.

Foamed Phenolic Resin

THE use of Bakelite phenolic foam for large-scale commercial packaging has reduced packaging and shipping costs through savings in breakage and postage with supplementary benefits in reduced handling of claims and lower insurance costs. Shown by Bakelite Company at the National Packaging Exposition and developed at Bakelite Laboratories, Bakelite foamed phenolic resin has been successfully adapted and tested in actual use as a packing material by Miles Kimball Company, Oshkosh, Wis., a specialty mail-order house. Produced in large five-foot cubes easily lifted by one man, Bakelite phe-

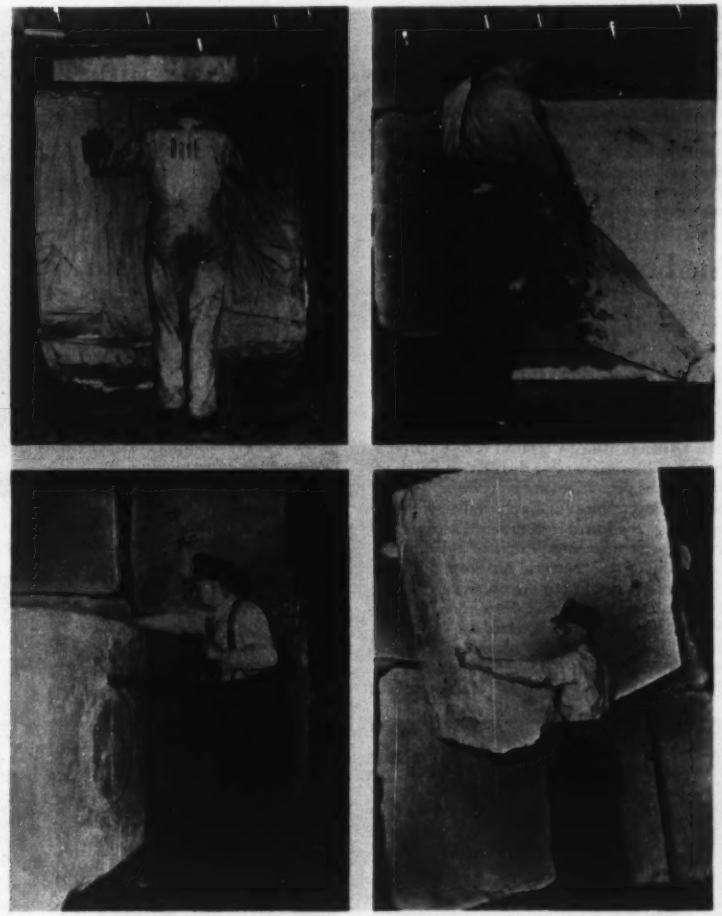

FIG. 1 FOAMED PHENOLIC RESIN PACKAGING MATERIAL REDUCES BREAKAGE, PACKAGING, AND SHIPPING COSTS

(After a short holding time, the block of foam is discharged by opening the sides of the mold, *top left*. Kraft paper, lining the mold to insure easy separation, is then stripped from the foam block, *top right*. The block is readily cut into convenient slabs with an ordinary timber saw, *bottom left*, and easily carried to storage by one man, *bottom right*.)

nolic foam has about one seventh the weight of top-grade shredded paper packing. This is equivalent to about one tenth the weight of ordinary shredded newsprint commonly used for packing.

This lightweight foam is said to combine flame resistance, high resilience, attractiveness, and neatness, with extremely low density, thermal insulating properties, and ease of handling. Production rates up to 700 cu ft per hr with two operators are possible since this foaming process takes only 45 sec from beginning to end. According to reports, one year's operating experience by the Miles Kimball Company has proved that Bakelite phenolic foam reduces packing time, increases efficiency by lowering worker fatigue, and saves expensive warehouse space generally used for storing packing materials. Postal and express shipment charges based on weight were reduced. Claims for breakage of fragile items such as stemware, glassware, and ceramics also are sharply reduced.

The simple conversion process for making phenolic foam involves mixing fluid Bakelite phenolic resin with an acid catalyst at room temperature, aerating with a mechanical stirrer, and pouring into a simple mold. Continued expansion of the foam to about 200 times its original volume, fills the mold in 15 to 30 sec, see Fig. 1.

With a density between 0.3 and 0.4 lb per cu ft, this foam is the lightest dunnage material available in large quantities. Good resilience makes phenolic foam a good packing material because it retains cushioning effects even under compression of several hundred pounds per square inch. Foam produced from

Bakelite phenolic resin and catalyst does not burn readily and is classed as self-extinguishing. Thermal insulating properties that compare favorably with glass and rockwool also make this versatile foam useful for packing perishable materials. Because of a grain effect produced in the expansion, heavy items are packed parallel to the grain for maximum compressive strength. Fragile glassware and ceramics are pressed into the end grain of the foam to form cavities that prevent shifting and breaking against each other. Precut slabs of foam in one to two-inch thicknesses cut down over-all packing time and make it easy to fill spaces by breaking off the right-size piece.

Air Foam Systems

AIR Foam, a new fire-fighting substance developed several years ago by National Foam Systems, Inc., and used extensively in aircraft and shipboard fire fighting during World War II, is daily proving its adaptability for industry use, according to the "Automatic" Sprinkler Corporation of America, Youngstown, Ohio. One such case is the specially designed Air Foam system recently installed at the Syracuse, N. Y., plant, The Solvay Process Division, Allied Chemical & Dye Corporation, in the company's chlorination and distillation buildings where benzene and benzene derivatives are processed.

Reports indicate that operational and approval tests of the fire-fighting equipment, conducted for fire-insurance underwriters and Solvay Process upon completion of the installation, prove the adaptability of Automatic Air-Foam Sprinkler systems for many hazardous manufacturing operations. These systems are said to combine the advantages of automatic sprinklers, water spray, and foam fire-protection media.

Proved operational and engineering advantages include: (1) Lower water-supply requirements, (2) reduced drainage requirements, (3) positive extinguishment of fires caused by flammable liquid spills, (4) prevention of flashback following fire extinguishment, (5) prevention of fire or explosion through manual operation of systems in the event of flammable liquid spillage, and (6) decreased cost of over-all fire protection.

FIG. 2 NEW FOAM-WATER SPRINKLER OPERATES EFFECTIVELY WITH EITHER WATER OR FOAM DISCHARGE

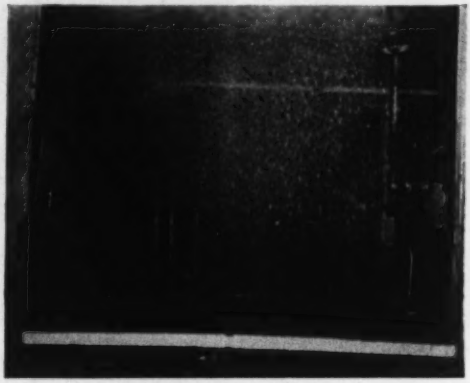

FIG. 3 AIR FOAM DISCHARGE AT BEGINNING OF SYSTEM OPERATIONAL AND APPROVAL TESTS

FIG. 4 THIRTY SECONDS AFTER SYSTEM OPERATION DITCHES ARE FILLED WITH AIR FOAM

SYSTEM DESIGN AND OPERATION

Designed by "Automatic" Sprinkler Corporation of America, the Air Foam systems depend upon the integration of deluge sprinkler equipment and a foam-injection system. Foam dis-

FIG. 5 FOLLOWING AIR FOAM, WATER DISCHARGE DOES NOT DISTURB FOAM BLANKET

charge outlets are located in accordance with Underwriters' requirements for automatic sprinklers. But water pressure at the outlets is maintained at 50 psi, rather than the 7 to 8 psi normally maintained on deluge sprinkler systems. These higher pressures break up the water to the fineness of water-spray discharge. System operation is obtained by means of standard rate-of-temperature-rise heat detectors, spaced at intervals throughout the buildings. They automatically detect fire, open the deluge valve in the water-supply line, and permit the injection of a foam liquid stabilizer into the sprinkler-system riser. The mixture of foam stabilizer and water is then aerated into a tenacious fire-fighting foam at the discharge outlets of the systems.

Air Foam is discharged at the rate of 2.0 gpm per sq ft, equivalent to a floor depth of approximately 3 in. per min. Sufficient foam liquid stabilizer is available to permit systems to operate normally for 10 min after which water spray will discharge from the outlets for as long as desired, still providing effective fire protection above the foam blanket.

During the first 10 min of operation, water is contained within the Air Foam bubbles, thus allowing full usage of the drainage capacity for dissipation of spilled flammable liquids.

Following operation, water flowing from the systems will wash away all foam clinging to the ceiling and processing equipment, and full clean-up can be accomplished in a short time.

The Air Foam stabilizer system is also connected to hydrant stations and can be extended to other buildings if desired.

Air Foam protection is a 24-hr-day guardian for Solvay's chlorination and distillation buildings. Completely automatic in operation, an alarm will instantly sound in the event of fire or mechanical injury to the fire-protection equipment.

INDUSTRIAL APPLICATION

Though primarily applicable for installation in buildings housing processing and pumping equipment, Automatic Air Foam systems are ideally suited to combat three-dimensional fires in buildings where flammable liquids for flashpoints lower than 150 F are used. Adaptations of these systems are available for petroleum-processing properties, steel by-products plants, food and pharmaceutical processing operations, etc. A mechanical foam stabilizer, capable of producing an alcohol stable foam, is available for use with this equipment. It must be pointed out, however, that each application requires an individual fire-engineering study, giving consideration to the chemical characteristics of the flammables, water requirements, drainage facilities, corrosive conditions, and the like.

Process Instrumentation

WHILE it is difficult to summarize recent developments in process instrumentation strictly in terms of new-product descriptions, a clear concept of what really is happening in process instrumentation was given by J. Procopi and S. D. Ross, Brown Instruments Division, Minneapolis-Honeywell Regulator Company, Philadelphia, Pa., at the recent Atlanta, Ga., meeting of the American Institute of Chemical Engineers.

Some of the trends noted by the authors were as follows:

1 Centralization of control with its emphasis on elimination of the problems of (*a*) lags attendant to long transmission distances, (*b*) confusion of operators who had to memorize the functions of scores of instruments, all similar in appearance, and (*c*) large size and cost of central control houses.

2 Segregation of important data through scanning and monitoring.

3 Direct product quality control with less dependence on inferential measurements.

4 Recognition of servomechanism techniques in the application of instruments to processes.

5 Incorporation of computer techniques into process control.

CENTRALIZED CONTROL

The authors pointed out that in the years which immediately followed the emergence of continuous processing, locally mounted indicating and recording controllers were employed to regulate process variables.

Early attempts to effect closer supervision and better co-ordination took the form of locally mounted panel boards. The next step was a grouping of these individual panel boards into one control board which was mounted in a centrally located control room.

With processing increasing in size and complexity, the number of instruments employed continued to increase to the point where control panels became large and unwieldy.

In order to improve over-all process supervision and to minimize the confusion resulting from over-enlarged panel boards, many attempts were made years ago to effect a graphical representation of the process on the control board.

Out of the period of gradual development which followed emerged the graphic panels as we know them today, the authors said.

In one type of panel, the semigraphic, only small dial-type industrial instruments are placed in the flow diagram. Miniature recorders and controllers, as well as those of conventional size, are mounted below and alongside the diagram. Colored symbols are employed on the instruments and in the flow diagram, in order to indicate the points of application.

Contrasted to this method of instrument mounting is the full graphic panel which utilizes miniature recorders and indicators mounted directly in the flow diagram. In this type, as in the semigraphic panel, the use of color is important in keeping streams identified.

Concurrent with this graphic panel activity has been the de-

velopment of industrial-instrument components that permit close-coupled control systems, thus resulting in a minimum of transfer lags.

It is generally agreed that graphic panels effect a reduction of panel-board space and of the size and cost of a control room. In addition, plant operating personnel, with little prior knowledge of the process being controlled, are appreciably aided in following flows, with the result that operator training time is greatly reduced. Instrument down time is decreased, a benefit made possible by the fact that these miniature instruments can be quickly interchanged. Also, graphic panels are easy to install and simplify start-up procedure.

SEGREGATION OF IMPORTANT DATA

Dial and scanning systems are additional manifestations of the present era. In a dial system, a manually supplied impulse starts a chain of actions that results in switching any desired measuring element of several hundred into a measuring circuit, so that the magnitude of the pertinent process variable may be recorded or indicated. In a scanner, a timed impulse replaces the manual one employed in the dial system. Indicating-type dial and scanning systems that are equipped with alarms are termed "monitors" whereas recording types are referred to as "loggers."

According to the authors, the Sun Oil Company recently designed a dial system, by which to check the temperature of a specific thermocouple, the operator simply dials three numbers. The system is arranged so that the next nine thermocouple points to the first thermocouple can be checked by simply adding one impulse at a time.

A scanner-monitor-logger has been designed in which a timed impulse, operating in conjunction with the recorder printing mechanism, initiates a chain of action which automatically switches one thermocouple at a time into the measuring circuit. This switching action also energizes the "point" and "bank" lamp on the face of the control unit.

In one particular unit there are nine banks of nine points each, or a total of 81 thermocouple points. Various switches in this unit provide flexibility in operation. Any bank may be recycled or omitted, as desired. Printing can be continuous, or, by simply throwing a switch, the instrument can be made to print only when the set point is exceeded.

DIRECT PRODUCT QUALITY CONTROL

Another significant trend in process instrumentation is in the direction of increased utilization of continuous analyzers in the control of petroleum and chemical product quality, they pointed out.

Proponents of product quality-control philosophy point to the numerous benefits attendant to its use, such as better control, improved equipment design, higher yields, and an acceleration of research made possible through faster more accurate analyses than are possible by current sample-to-laboratory methods.

A mass spectrometer was recently installed at the Paulsboro refinery of Socony-Vacuum Oil Company for continuous analysis of a de-ethanizer bottoms stream. Concentration of ethane was continuously and accurately recorded during a test period of several months' duration.

Similarly, infrared analyzers have been used to determine carbon-dioxide content of flue gas of a fluid catalytic-cracking unit and a host of other applications. Continuous density-recording mechanisms measure per cent conversion of monomers in butadiene-styrene copolymerizations. Continuous testing dielectric constant meters determine the concentration of aromatics in a mixture of hydrocarbons, while continuous refractometers analyze the composition of olefins in a mixture.

SERVOMECHANISM TECHNIQUES

The last decade has witnessed extensive engineering activity in a new approach to control problems called servomechanism techniques.

To servomechanism engineers, the control problem involves a study of the dynamics of an entire system. This "system-engineering" concept embodies not only a consideration of the dynamics of the process, but also of the measuring instruments and control devices. These dynamics can be expressed mathematically over their entire range of behavior in terms of frequency response.

These frequency-response curves have a sound theoretical basis and are easily manipulated by those who do not wish to delve deeply into mathematics. They are used to assist in selecting the type of controller required and to calculate controller settings required for efficient operation.

COMPUTERS

Coincidental with the increasing activity in servomechanisms is the tremendous development that is currently affecting computing machinery.

Digital computers, for example, can be used quickly and accurately to make difficult calculations required in designing distillation towers for multicomponent systems. Other engineering calculations related to design of unit operations such as absorption, extraction, and drying can similarly be effected on computers of this type.

Computers eventually may play a significant role in automatic control, the authors stated. Of course, present-day pneumatic controllers are computers, and more specifically, analog computers, by definition. However, as the name implies, the function or physical quantity operated on is analogous to the original signal, and as such is related only indirectly to the actual dynamics of the process being controlled, and to quality factors in the product. Servomechanisms techniques supply the answer to the question of how to tie in the dynamics of process and instruments. The computer, on the other hand, may be the means of bringing quality control into the loop.

A suggestion has been made as to how this may be accomplished. Product viscosity, which is closely related to product quality, is measured and returned to the control loop. Process variables of temperature, pressure, and ratio of materials are controlled by conventional instruments. The computer is used to interpret the quality measure in the light of process dynamics, and, in turn, establishes regulation over the various process variables.

Better Lubricants

BETTER lubricants for modern high-speed machines are indicated in three Navy research reports now available to the public, the Office of Technical Services of the U. S. Department of Commerce reported.

How the molecules of the different chemicals in a lubricant interact with each other and with the lubricated surfaces is discussed in one report which is entitled "Surface Chemical Phenomena in Lubrication." In this report the Navy scientists endeavored to put together an integrated picture of the scientific knowledge developed to date on the molecular phenomena involved in lubrication. This picture shows how the molecular forces of colloids, films, and corrosion inhibitors affect the lubrication process. The treatment is presented under these chapter headings: "Some Results of Recent Research on Adsorption of Long-Chain Compounds," "Rust Inhibitive Properties of Amphipathic Films as a Tool for Studying Adsorption," "The Relation of Rust Inhibition to Wear Prevention," "Colloidal

Phenomena in Nonaqueous Liquids," "Boundary Lubricating Properties of Aliphatic Esters."

In many modern machines gears and bearings operate under very heavy loads and high speeds. Few lubricants stand up under these severe conditions. Navy scientists, using a testing technique which dependably simulates actual machine conditions, investigated the effects of various components of synthetic lubricants under those conditions. Their report (1) describes tests made to determine the dependability of the techniques used; (2) indicates some useful procedures for testing various lubricant compositions under these severe conditions; (3) indicates the behavior, under these high-load and high-speed conditions, of the following lubricant materials: petroleums and hydrocarbons, silicones, diesters, and polyglycol ethers. "A Study of the Four-Ball Wear Machines" is the report title.

In the course of a Naval Research Laboratory program to develop nonspreading lubricants for low-temperature applications, it was found necessary to synthesize two groups of esters and ethers. One group was needed to enable the scientists to investigate how the spreading lubricants work; another group was needed to provide suitable liquid compounds for developing the nonspreading lubricants required for service.

A Naval Research Laboratory report describes the synthesis of 30 such compounds. Since the spreading behavior of these compounds may be influenced by small concentrations of impurities such as alcohols and acids, synthesizing techniques were used that produced products of high purity. The report therefore describes the special precautions observed in the synthesis to obtain products of high purity, which precautions included: The use of pure starting materials; refractionation of all products; stripping of all redistilled products to remove traces of volatile compounds such as alcohols and acids; and removal of polar impurities by percolation through suitable absorbents.

Since the products synthesized were new or inadequately described in the literature, they were identified and characterized by determining the following physical and chemical constants: Boiling point, density, refractive index, surface tension, molecular refraction, parachor, and kinematic viscosity. These identification tests are also described in the report which is entitled "Synthesis and Characterization of Esters and Ethers for Nonspreading Lubricants."

PB 103 774, "Surface Chemical Phenomena in Lubrication," 29 pages including tables, graphs, and bibliography sells for 75 cents.

PB 103 606, "A Study of the Four-Ball Wear Machine," 52 pages including graphs, photographs, diagrams, and bibliography sells for $1.50.

PB 106 130, "Synthesis and Characteristics of Esters and Ethers for Nonspreading Lubricants," 17 pages including tables and references sells for 50 cents a copy.

Orders should be addressed to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., accompanied by check or money order payable to the Treasurer of the U. S.

Railroad-Safety Film

GREATER Safety Week in New York City was marked by the Pennsylvania Railroad through premiere showings of a new training film for employees, entitled "Not By Chance." This 33-minute narrative drama in color will be shown to some 18,000 Maintenance of Way Department employees and others throughout the railroad's system. It is one of a group of new films on the subject of safety which have received special awards from the National Safety Council.

Using authentic case histories from the files of the Safety Department, the picture points out how innocently the average worker can get into a jam which may lead to disaster. Aimed at the 99 out of every 100 men who secretly anesthetize their safety consciousness with "it can't happen to me—maybe the other fellow is careless, but I can take care of myself," the story shows with dramatic realism how the little slip, the natural mistake, the casual lapse of memory to which every one must occasionally confess, can just as casually lead to terrifying reality when an accident may be least expected. By showing that the average worker can, by a moment of inattention to the rules, get into serious difficulty, the man in the audience is forced to place himself in the position of the victim and to realize that it can happen to him too. Thus it is shown that these rules do apply to the experienced, intelligent worker and are useful to him as well as to beginners.

Copies of the film, as soon as they are available, for use at Section, Student Branch, or other Society meetings, can be obtained from J. T. Williams, Manager of Safety, Pennsylvania Railroad, Philadelphia, Pa.

Plastic Deformation

A PLASTIC material, which he said had the properties of steel, was described by Dr. Miklos Hetenyi, Mem. ASME, professor at Northwestern University's Technological Institute and internationally known stress analyst, before a recent meeting of the Society for Experimental Stress Analysis, in Indianapolis, Ind. He told how he accidentally discovered the special nylon plastic which will enable him to reproduce the conditions which have caused many structures to fail under normal loading.

The discovery, he pointed out, will enable scientists to study construction methods which have led to sudden failures of such things as bridges and buildings. Dr. Hetenyi said he did not foresee substitute of the plastic for steel in the immediate future.

Dr. Hetenyi has pioneered in the field of photoanalysis. Scale models of metal pieces, but made of plastic, are subjected to stresses similar to that which they would undergo as metal bridges or other structures. Using ultraviolet light, Dr. Hetenyi has been able to see—and photograph—test results.

Previous experiments had one serious limitation, however, which the new plastic will correct. Formerly, the special plastic material used would duplicate the properties of steel only in the elastic range, where no permanent deformation takes place. He began his search for a material that would work even where permanent deformation results. Then recently, he came across the thin sheets of special nylon plastic, made for experimental purposes by the du Pont Company. Testing proved they duplicated exactly the properties of steel in both ranges.

Corrosion Testing

FIRSTHAND opportunity to inspect the International Nickel Company's corrosion-testing facilities at the new marine testing station at Harbor Island, near Wrightsville Beach, N. C., and the sea-spray and atmospheric studies being made at Kure Beach, was afforded a group of technical editors on April 23 and 24.

Among the new facilities at Harbor Island is a full-sized salt-water evaporator and distillation unit to study the effects of water treatment and design on the scaling of such units—especially as used on board ship. The unit is fed by a boiler with a capacity of 4000 lb of steam per hr.

This study is being carried out for the United States Navy, for whom the Kure Beach Project has long served as a research outpost.

To make room for the evaporator and other equipment, a new two-story laboratory building has been erected. It, together with the original laboratory building, now provides 8000 sq ft of indoor space. It contains a meeting hall that will accommodate up to 75 people as well as additional laboratory, study, office, machine shop, and other space.

At Kure Beach, a new sea-spray test lot has been erected about 80 ft from the shore. This provides a capacity almost three times that of the former sea-spray test lot which was located near by.

Inco engineers pointed out that comparative tests first at Kure Beach and now at Harbor Island and in synthetic sea water in the laboratory have shown definitely that laboratory conditions are quite inadequate for measuring the behavior of metals and alloys.

In the sea-water tests, most specimens are exposed on racks continuously immersed at a depth of from 2 to 7 ft, depending on the tide level.

Facilities also have been provided, however, for hanging specimens from a large pontoon float, when it is desired to maintain a constant water line or a constant depth of immersion in spite of the rise and fall of the water with the tides.

FIG. 7 INSPECTING SPECIMENS IN THE SEA SPRAY LOT LOCATED ABOUT 80 FT FROM THE SHORE LINE

VELOCITY EFFECTS

The need for more precise information on the abilities of alloys to withstand the severe erosive effects associated with such uses as condenser tubes, piping systems, pump impellers, propellers, and other underwater parts of fast-moving ships has led to the design and operation of several types of erosion testing apparatus.

There is, for instance, what is called the EES Erosion Testing Apparatus developed by the U. S. Naval Engineering Experiment Station at Annapolis, Md. By means of this device, specimens in the form of bars or tubes are whirled through violently agitated sea water at velocities up to 30 fps.

Then there is a battery of rotating spindles to which are attached test pieces in the form of disks which are rotated at high speed in sea water. This type of specimen and motion provide a velocity gradient from center to periphery and demonstrate clearly the critical velocities above which protective films are unable to adhere.

One piece of equipment, called the aspirator type of jet testing apparatus, was developed at Kure Beach. This device subjects test specimens to the erosive effects of high-velocity jets of sea water mixed with air bubbles. It has been particularly useful in developing and evaluating condenser-tube alloys resistant to "impingement attack."

Another type of impingement test apparatus used was designed and built in the laboratory of the British Non-Ferrous Metals Research Association with whom co-operative investigations are being carried on.

For studying the action of sea water flowing at moderate velocities, specimens are immersed in troughs, the total length of which amounts to about 600 ft and accommodates several hundred test pieces for both erosion and corrosion tests.

FIG. 6 NEW CORROSION-TESTING STATION AT HARBOR ISLAND, N. C.

Other effects of velocity are being studied by practical trials of full-scale units such as an oil cooler manufactured by the Harrison Radiator Division of General Motors Corporation. This test setup also includes provision for the testing of many small models which simulate the full-scale units and permits studies of changes in materials and design as a preliminary to full-size construction.

The use of full-size units in this way has the advantages over ordinary shipboard trials that operation can be made continuous or to follow any desired cycle, and the conditions of use can be altered at will to suit the requirement of the test program without the restrictions imposed by the operating requirements of shipboard installations.

A special setup is used for

studying the galvanic potential relationships among metals and alloys that are used together in sea water. Here, the specimens remain stationary in a hard-rubber holder in which they form the walls of a narrow channel through which sea water may be passed at velocities up to 15 fps. In addition to permitting measurements of potential and current flow, this apparatus is used for studying the polarization characteristics of the metals, of fundamental importance in predicting and explaining their galvanic behavior.

Finally, effects of velocity are studied more directly by setting up model piping systems and experimental condenser tube bundles which duplicate the flow conditions of ordinary service.

These several methods of test reproduce the kinds of attack encountered in service and permit resistance to erosive effects to be measured quantitatively over relatively short periods of time. Since the results for standard materials have been correlated with long-time service experience, it is possible to determine the probable merits of alloy modifications or new compositions in relatively short periods of time.

A large amount of sea water must be supplied for the several tests in which effects of velocity are studied. At the present time this requires the pumping of over 7 million gal per day, or about the same as the volume of fresh water used in the nearby city of Wilmington.

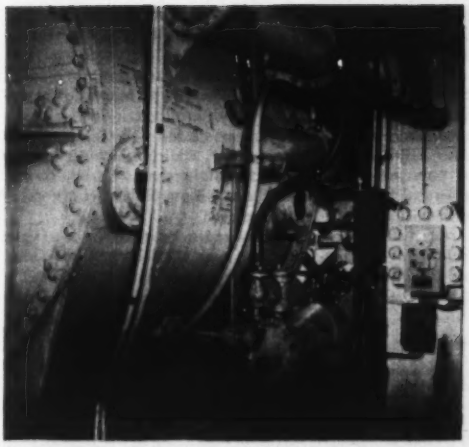

FIG. 9 FULL-SIZED SALT-WATER EVAPORATOR AND DISTILLATION UNIT FOR STUDYING EFFECT OF WATER TREATMENT AND DESIGN ON CORROSION AND SCALING OF SUCH UNITS AS USED ON BOARD SHIP

EFFECT OF MARINE FOULINGS

The study of the antifouling characteristics of metals, alloys, plastics, and protective coatings has been an important phase of Inco's research program.

Specimens are fastened to the rack by means of Monel machine screws. Galvanic effects are prevented by the use of bakelite insulating tubes over the bolt shanks and insulating washers between the specimens and the racks and the Monel washers under the boltheads. In another design of rack, the specimens are held in grooves in porcelain insulators fastened to Monel racks by Monel fastenings. Incidentally, some of the original lot of Monel screws and nuts are still in use and in excellent condition after 16 years. The adequacy of these methods of avoiding galvanic action has been demonstrated by the absence of such effects on specimens of such materials as magnesium, aluminum, and zinc-coated steel.

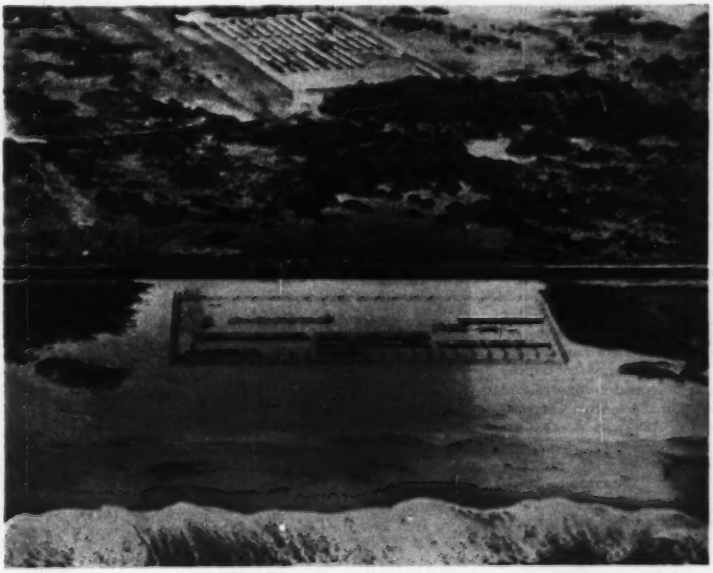

FIG. 8 SEA SPRAY AND ATMOSPHERIC TESTING LOTS AT KURE BEACH, N. C.

The period of exposure of a group of specimens may vary from 6 months (rarely less) to several years—the longest to date—12 years. The number of specimens exposed varies from about 2000 to 3000, depending on the nature of the investigations in progress.

This includes also many studies of destructive marine borers, ship worms, and means of avoiding their damaging effects carried out in close cooperation with the William F. Clapp Laboratories, Inc., possibly the leading international authorities in this field.

PROTECTION OF MARINE PILING

As a continuation of the full-scale tests of marine piling in the basin at Kure Beach, advantage was taken of the necessity of building the new rack-supporting structure or "dock" at Harbor Island to make each pile serve as a test piece. In addition to

timber piles treated with different preservatives against marine borers, the several steel piles being used have been given several types of protection against corrosion.

These range from the best of modern organic coatings through hot-dipped and sprayed metallic coatings to Monel and cupronickel sheathings, which are applied to the critical tidal zones by different means—from integral cladding to welded or mechanically fastened wrappings. In addition, a large number of piles are being given cathodic protection from current generated by magnesium anodes as a supplement to the other means of protection being employed.

Many other materials under test also have been made to serve utilitarian purposes. The roof over the laboratory building, for instance, is of welded Monel roofing sheet. The fence around the laboratory is in two sections—one of 18 per cent chromium, 8 per cent nickel stainless steel, and the other of galvanized steel.

OVER 25,000 SPECIMENS IN ATMOSPHERIC RACKS

Since corrosion by marine atmospheres is equal in importance to corrosion by salt water, facilities have been provided for extensive atmospheric-corrosion tests. Up to the present time over 25,000 specimens have been exposed by Inco and cooperating companies. This lot is located at Kure Beach about 250 yd from the ocean shore. The test racks face south and the specimen frames are set at a slope of 30 deg from the horizontal.

New specimens of certain key materials are put on the racks each time a large group is removed, or a new group is installed. These key specimens provide information on changes in the corrosivity of the atmosphere itself from year to year which assisted in the interpretation of the results of tests made over different time periods.

One large group of about 1500 specimens of different steels was distributed over the racks at random so as to discover any possible effects of rack position on the results obtained. So far, no such effect of position has been observed.

In order to provide for more drastic conditions of exposure to salt air and sea spray, the original atmospheric test lot at Kure Beach has been supplemented by another group of test racks located about 80 ft from the shore line. This lot has an area of about an acre and will accommodate about 20,000 standard-size specimens.

The close proximity of these racks to the surf breaking on the adjacent beach makes the corrosive conditions very severe. Some steels are corroded ten times faster here than in the main test lot further from the ocean.

Pictorial Computer

OPERATIONAL safety on the airways was brought a step closer by the unveiling of a recently completed instrument which automatically calculates an aircraft's distance and azimuth from a known point of radio transmission on the ground. The instrument is called a pictorial computer and was designed, developed, and manufactured by Arma Corporation of Brooklyn, N. Y., a subsidiary of American Bosch Corporation.

Smaller than radio equipment of earlier vintage, the pictorial computer mounts flush on the airplane instrument panel. There, within detail seeing range of both pilot and copilot, it continuously displays on a luminous screen the exact orientation of the aircraft with respect to the ground. Accuracies claimed are: Range ± 0.4 mile at all scales, bearing $\pm 1/2$ deg or $\pm 1/32$ in., and heading indicator ± 1 deg.

Navigation with the Arma pictorial computer is based on the Omni-Bearing Distance System and is simply a matter of selecting a proper chart and keeping the aircraft heading, corrected from crab angle, in line with the route or destination.

The charts against which position and heading are shown in the display unit are self-contained, and are quickly selectable by means of a slewing control on the front of the unit. The equipment is composed of two principal units: the display unit; and the amplifier unit, containing all relays, special power sources, and amplifiers. The amplifier unit is intended to be mounted in the radio rack of an aircraft and is of a standard outline size.

Aircraft heading and position are shown against a chart of the area. The chart is part of a 35-mm film roll in the display unit, and is projected at 10× onto a 10-in-diam, see-through-type screen. At the center of the chart is an omnibearing distance (OBD) station, which is the fixed geographical point from which the pictorial computer and associated equipment calculate range and bearing for position indication. Aircraft position is indicated on the chart as the center of a reticle of concentric range circles and radiating bearing lines. Aircraft heading is indicated on the chart by a series of arrows passing through the aircraft position and, in addition, by a symbolic aircraft outline. Heading may be read to one degree against compass roses superimposed on several range circles. Any point on the chart may be headed for simply by turning the aircraft until the heading indicator points toward and falls over the chosen spot. Then, except for the crab angle necessary to compensate for wind set and drift, the aircraft will, in due course, pass over the required point. Setting up the crab angle is easy to do, since it is necessary only to swing the aircraft into the wind in increments until the required point on the chart is held at a constant bearing. Bearing lines are conveniently spaced so that small changes in bearing may be detected quickly.

Charts are provided at four scales: 1:2,000,000 (Direction Finding Charts); 1:1,000,000 (Route Charts); 1:500,000 (Sectional Charts); and 1:250,000 (local Charts). Chart diameters are 274, 137, 64, and 34 miles, respectively.

Storage facilities in the display unit allow for a film roll containing up to 700 charts. The total number of OBD stations

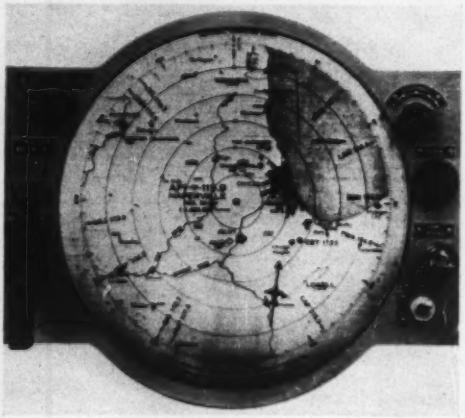

FIG. 10 PICTORIAL COMPUTER FOR AIRPLANES

(This is all the pilot sees of the device when it is mounted in the instrument panel. "Bug" in lower right of screen represents plane's position on map. It tells exactly where plane is regardless of visibility.)

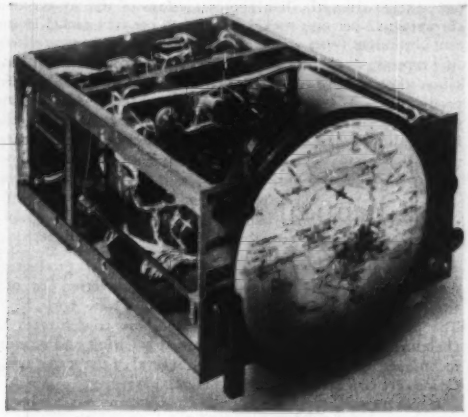

FIG. 11 DISPLAY UNIT WITH COVER REMOVED

presently authorized is 291, so that the designed chart capacity allows for charts at various scales, as required, including some to be used for small-scale airport approach charts.

Charts are situated on the film in a "route sequence" order. The route sequence is made up of a series of film strips, each strip containing the charts for OBD stations encountered in a route between two terminal cities.

Associated with each chart in the film roll there is a series of eleven on-off coded locations. Nine of these locations are used to identify the particular frequency combination of the OBD station transmitters and transponders situated at the center of each chart. Two are used to set the scale of the instrumentation automatically to correspond with the scale of the chart. The coded locations consist either of holes or no holes in the film roll. Fingers interrogate each coded location as soon as the chart has been selected. The fingers actuate a relay network in the amplifier unit, which in turn controls automatically and remotely the autopositioner tuning mechanisms in both the navigation receiver (bearing) and distance measuring equipment (range), so that, after a particular chart has been selected at the display unit, inputs to the pictorial computer are returned automatically to the new OBD station.

Instrumentation of the Arma pictorial computer is accomplished with three servos: Range, bearing, and heading. All are of conventional design and operate on 400-cycle signal inputs. Range is obtained from the shaft orientation of a potentiometer in the distance measuring equipment, which calculates the distance, up to 115 miles, to the OBD stations to which it is turned. Bearing is obtained as a single speed, 400-cycle synchro signal from the omnibearing indicator, a unit of the navigation receiver which calculates bearing to the OBD station to which the receiver is tuned. Magnetic heading is received as a 400-cycle single-speed synchro signal from the gyrosyn compass.

The display unit is about 13 × 7½ × 17½ in., except for blisters at the front (screen end) to accommodate the 10-in-round screen, and another blister at rear to accommodate the lamp house of the projector system and its blower. It weighs about 16 lb. Dimensions and weight do not include shockmounts.

The amplifier unit is packaged within the outline of a standard S-2 case and weighs about 21 lb. It is to be mounted in the communications rack of an aircraft, and the foregoing figures include shockmounts.

Special new charts will be furnished for use with the Arma pictorial computer. They will be prepared by the U. S. Coast and Geodetic Survey in co-operation with the Civil Aeronautics Administration, and will be designed for use by high-speed aircraft and for all types of flying where visual ground contact is not maintained. Chart legends will be clearly visible from a distance of 40 in., about the distance of the instrument panel from the pilot's eyes. Charts will be prepared in solid black and half tones, and will contrast with the position and heading indicators of the pictorial computer.

Spiral-Wound Gaskets

TEST equipment engineers of a large manufacturer of aircraft subassemblies, were recently confronted with the problem of gasketing of flanged joints in hot gas lines. These lines, approximately 10 in. in diameter, carry combustion products at temperatures as high as 1850 F to units under test. The pressures involved are relatively low, live pressure being 50 to 60 in. Hg abs, and external pressure going 4 to 10 in. Hg abs. The units are tested in altitude chambers with steam ejectors maintaining the pressure level. The continuous failure of fibrous gaskets permitted the hot gas to leak into the altitude chamber, causing rapid deterioration of thermocouple and power wiring. It was necessary to admit air from atmosphere into the chamber to limit the cell temperature to a safe level. This, of course, imposed an additional load on the ejectors and usually required the cutting in of an additional ejector with an increased steam demand.

Reports indicate that warpage and burning caused the failure of the many types of gaskets tried in this application. Cooling jets and pressurized joints were either too cumbersome for the repeated setups, or further problems were introduced. As a possible solution, therefore, engineers of the Flexitallic Gasket Company, Camden, N. J., recommended a spiral-wound gasket of type 347 stainless steel, with a thickness of 0.175 in. with asbestos filler and stainless retaining ring. In addition to the temperature problem, the flanges and bolting were relatively

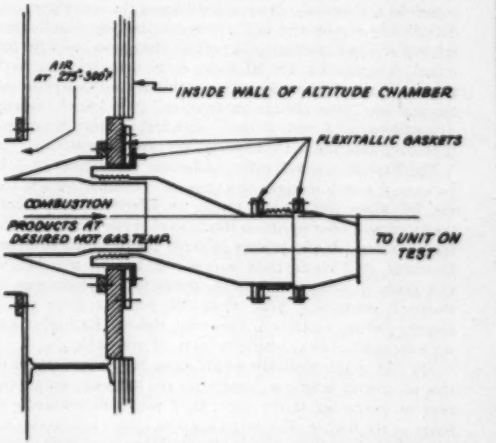
AIR AT 275°-300°
INSIDE WALL OF ALTITUDE CHAMBER
FLEXITALLIC GASKETS
COMBUSTION PRODUCTS AT DESIRED HOT GAS TEMP.
TO UNIT ON TEST

FIG. 12 ELEVATION OF HOT-GAS INLET DUCTING SHOWING INSTALLATION OF SPIRAL-WOUND GASKETS

light to avoid high thermal inertia and to shorten the test setup time. Four gaskets were made up and two were installed as shown in Fig. 12. It was necessary to sandwich the gaskets between stainless-steel rings, since the center-to-face dimensions varied with different types of test machines.

The first tests were made during standard production test runs. These consisted of half-hour runs at 1600 F. At the end of each run, the removal of the machine required the dismantling of the adapter assembly and the breaking of the gasketed section. The gaskets were used in this arrangement continuously for over a week, as some 24 units were tested. During this period, the quantity of atmospheric air introduced into the chamber was about 40 per cent of the normal amount. An inspection of the gaskets revealed no apparent change in filler thickness and only slight discoloration, according to the company. Both gaskets were reinstalled and were in use for an additional three weeks under similar service. At the month's end, an examination showed only further discoloration. (Prior to this, gaskets were replaced weekly, the company said.)

At this time a development unit was to be run on an accelerated life test. This test, of 60 hr duration, required an alternating temperature cycle, 30 min at 1800 F and 30 min at 250 F. This proof test was run on a three-shift operation and completed in a minimum time. No sudden rise in chamber temperature was observed at any time during the run, and based on the amount of atmospheric air used for cooling, the gaskets had maintained a tight seal. An examination of the gaskets revealed a considerable discoloration, slight warpage of the retaining ring, but no burnout of the wound element. Also, the reduction in steam consumption of this test, due to minimum bleed air, resulted in a saving many times the first cost of the gaskets.

Nickel-Conservation Research

CONSERVATION of vitally needed nickel and chromium in heat-resistant castings is the objective of important research announced by the Alloy Casting Institute of Mineola, N. Y. Conducted at the Battelle Memorial Institute, research has been concentrated on developing a heat-resistant material of lower alloy content than the high-nickel alloys frequently used in 900–1400 F service. From knowledge of the iron-chromium-nickel-alloy system and field experience, casting metallurgists selected an alloy containing 21 per cent chromium and 9 per cent nickel, designated as the HF type, as the material most likely to provide the combination of strength and corrosion resistance required for "intermediate temperature" (900–1400 F) service. According to ACI, tests to date indicate that this alloy offers a promising solution to the requirements of such service.

The Battelle research team, under the supervision of J. H. Jackson, is now investigating a series of 14 compositions within the HF alloy specification range, to determine which compositions will offer optimum mechanical properties at elevated temperatures. If the present research on HF alloy continues favorable, ACI states, then users should be able to substitute this grade in many intermediate temperature applications for materials containing from 30 to 100 per cent more nickel, thereby freeing supplies of this vital element for higher-temperature applications, where its use is indispensable.

The HF grade probably would have been investigated for this use a long time ago, except for the mistaken assumption that its properties in the 900–1400 F range are markedly inferior to the higher-alloy materials now used. Indications are, states ACI, that this incorrect idea doubtless arose from the fact that the wrought stainless steels containing about 18 per cent chromium and 8 per cent nickel have considerably less high-temperature strength than the cast alloys of the 25 per cent chromium-12 per cent nickel and the 35 per cent nickel-15 per cent chromium types. However, this is not true in cast alloys, ACI reports, since the latitude of compositions possible in cast alloys allows use of chemical ranges unsuited to wrought-alloy production. ACI claims that tests now being made indicate the cast HF material to have strength properties comparable to higher-alloyed cast grades at these intermediate temperatures.

Chemical Metals Refining

DEVELOPMENT of new techniques which, it is believed will drastically reduce current costs of metals production was announced recently by the Chemical Construction Corporation, a unit of American Cyanamid Company, New York, N. Y. The processes involve the treatment of ore concentrates by chemical methods, instead of the usual smelting and refining techniques, to produce pure metals. Several of the many applications are now scheduled for commercial use.

It was pointed out that although the company has conducted extensive fundamental research and development work on these techniques in a considerable part of the field of metallurgy, each commercial application requires specific technical adaptation and pilot-scale data for engineering design. In collaboration with Sherritt Gordon Mines Ltd., a nickel-copper-cobalt process has been researched and piloted for that company's Lynn Lake properties. Also, in view of the United States' urgent need for cobalt, processes were tailored for the cobalt concentrates of the Howe Sound Mining Company and the National Lead Company.

A vitally important development that may soon find com-

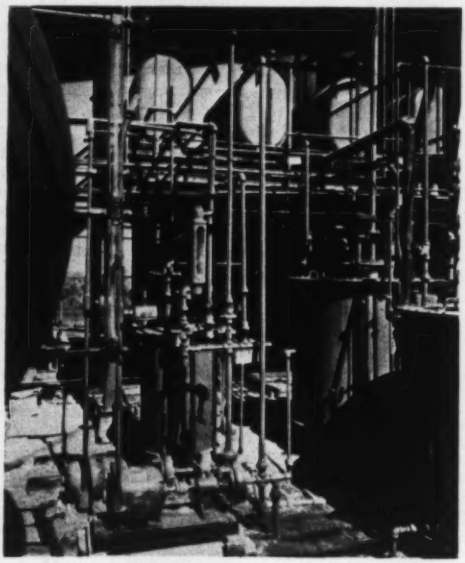

FIG. 13 TRANSFER TANKS IN FOREGROUND, AND STORAGE TANKS, AT TOP, INTO WHICH DISSOLVED SCRAP IS PUMPED FROM LEACHING VESSELS DURING ONE OF THE PRELIMINARY STEPS IN PRODUCING PURE COPPER POWDER FROM COPPER SCRAP BY NEW CHEMICAL METAL-REFINING METHOD

mercial application is a new process for production of pure copper powder from any form of copper scrap, brass scrap, or blister copper.

At Chemical Construction Corporation's pilot plant in Linden, N. J., the copper-scrap process begins with lowering a basket of scrap into a leaching solution where it will dissolve. This, and other steps in the process will be fully mechanized in commercial installations. From the leaching vessels the dissolved scrap is pumped to transfer and storage tanks. Solids are filtered out of the solution and the solution is then pumped to the measuring tanks which feed the autoclaves.

Heart of the process are the autoclaves where, under high temperatures and pressure with reducing agents, the copper is precipitated from solution. Two coils, one inside the other, are for heat exchange—heat from precipitated copper leaving the autoclaves is transferred to solution going into them.

Washing tanks receive the copper after it is precipitated in the autoclaves and wash away the leaching solution. Water and powdered copper pour out of the washing tank into a box filter for preliminary drying. Gleaming copper powder pours from a rotary drier, last step in the process. Commercial installations will include equipment for continuous drying.

Analysis in the pilot plant's laboratory shows the finished

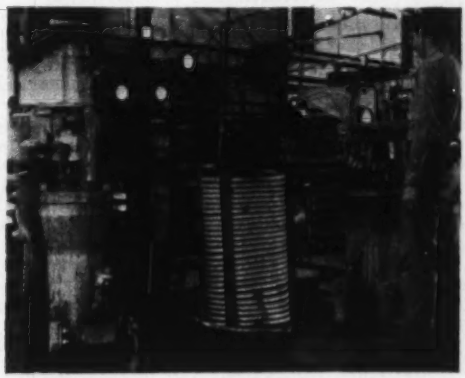

FIG. 14 AUTOCLAVES WHERE COPPER IS PRECIPITATED FROM SOLUTION UNDER HIGH TEMPERATURES AND PRESSURES WITH REDUCING AGENTS

product to be pure (better than 99.9 per cent) copper powder, which meets all standards for oxygen-free, high-conductivity electrolytic copper.

Compared with conventional methods, the company stated, piloting experience has shown that production cost, from ore concentrates to pure metals, should be considerably below current costs. Other savings, it was pointed out, may be realized by cutting transportation and personnel costs, and by reducing the present time lag between mining and pure metal from months to a matter of hours.

First commercial use of one of the processes will begin this summer when Chemico expects to complete the building of a $2,500,000 cobalt refinery for Howe Sound Mining Company near Salt Lake City, Utah. This plant will boost world output of the strategic metal, most of which comes from Central Africa, by more than 40 per cent. The plant will daily process 35 tons of 20 per cent cobalt concentrates from Howe Sound's Blackbird Mine near Cobalt, Idaho, resulting in yearly production of some 2000 tons of pure cobalt, about one half the United States' consumption of the metal in 1950.

FIG. 15 COPPER POWDER TAKEN FROM ROTARY DRIER, LAST STEP IN PROCESS, IS 99.9 PER CENT PURE

Also under construction at the Fredericktown, Mo., mine of National Lead Company is a $5 million refinery which is scheduled for completion in mid-1953. With a designed capacity of 50 tons of concentrates per day, the company plans to maintain an annual production at this plant of 700 tons of cobalt, 900 tons of nickel, and 700 tons of copper, plus 7500 tons of fertilizer-grade ammonium sulphate.

A unique development is the $17 million nickel refinery now under construction for Sherritt Gordon Mines Ltd., at Edmonton, Alberta, Can., in which the Sherritt Gordon ammonia leach process and Chemico's nickel reduction process are combined. The plant, scheduled to begin operation in the fall of 1953, will turn out mostly nickel and small quantities of cobalt and copper from sulphate ores mined at Sherritt Gordon's Lynn Lake holdings in Manitoba. Annual production at the refinery is expected to be about 8500 tons of nickel, 1000 tons of copper, and 150 tons of cobalt, plus 70,000 tons of ammonium sulphate. This will be the only major nickel refinery in the Western Hemisphere besides the large International Nickel Plant at Port Colborne, Ontario.

Bulk Mining

A MINING technique by which gigantic masses of ore, far underground, are induced to cave and disintegrate of their own weight, thereby enabling the recovery of millions of tons of nickel-copper ore once regarded as worthless, has been adapted by the International Nickel Company of Canada, Ltd., at its mines in the Sudbury District of Copper Cliff, Ont., Can.

Called "induced caving," this low-cost bulk-mining method, plus metallurgical practices, makes it practicable for Inco to recover and treat ore lower in grade than it had ever worked in underground mining. Thus the supply of economically availa-

ble ore has been broadened, aiding Inco in maintaining its current nickel production at a postwar high.

In caving, a "slice" which may contain as much as 1,500,000 tons of ore is undercut. As ore from the undercut slice is withdrawn, the slice to be mined breaks away and starts to disintegrate as it moves downward, the weight of the upper part of the mass acting to crush the ore at the bottom.

Another bulk-mining technique by which Inco is boosting its underground production is the "blasthole" method. Blasthole mining differs from caving only in so far as explosives are used to break the slices of harder tougher ore from the solid material. The force of gravity then takes over, as in caving.

In addition to these recent innovations the company continues to use a number of other mining methods by which the higher-grade ores are extracted with relatively little dilution as in the past.

The bulk-mining methods for recovering enormous quantities of lower-grade ore are part of a development program which, at a cost to date of $130 million, involves a shift in Inco's operations from combined surface and underground mining to all underground mining. Upon completion of the program, about the end of 1953, the company will be able to hoist 13 million tons of ore a year, or twice as much from underground as in any year prior to 1951. It will then have the largest mining operation of its kind in the world.

The transition to all-underground mining at Inco was speeded up by unprecedented demands for nickel. Surface mining is reaching the predetermined depth at which it is no longer economical. The open pit, the sides of which must be maintained at a slope of 45 deg for safety reasons, is tapering in width toward the point where the exposed part of the ore body is too small to be worked from above, forcing the change to underground mining. Whole new areas have been developed for ore production, more than 70 miles of new underground openings have been driven in the solid rock, and four new concrete-lined shafts, aggregating two miles in depth, have been sunk.

Inco has built at the site of one of the new mine shafts a concentrator with a present capacity of about 12,000 tons a day. Hoisted from the mine under push-button control, the ore is milled on the spot and a $7^1/_2$-mile pipe line carries the bulk concentrate to the reduction plants at Copper Cliff.

Pipe-Line Network Analyzer

A PIPE-LINE network analyzer, used in solution of problems involving pipe-line flows and pressure losses in pipe-line networks, has been installed by Midwest Research Institute, Kansas City, Mo. The McIlroy pipe-line network analyzer is one of three such devices in the United States. The others are located at Washington State College and Cornell University, where the first one was installed in 1949.

This 7-ft electronic and mechanical device has proved itself extremely valuable and a great timesaver, when several alternate plans are under consideration for construction, extension, or reinforcement of a pipe-line network, by cutting down the time used in calculations. Once the analyzer is set up for a specific problem, the answers can be obtained in about half an hour, where formerly it took days and weeks by trial-and-error methods.

Typical examples of the varied applications of the analyzer are found in studies such as determination of favorable location for pipe lines; selection of pipe diameters for best combination of economy and performance; effects of choice of elevation of reservoirs or storage tanks; and evaluation of pressure variations.

The analyzer utilizes a system of electrical analogies for physical factors involved in networks carrying water, oil, and natural gas, as well as steam-heating networks and air-conditioning systems. An electrical control board is used to duplicate an actual supply network, which can be composed of as many as 99 different supply lines. The operator can also control such factors as source, rate of flow, pressure, and other related elements.

Special tubes, known as fluistors, are employed and the amount of light reflected by these lamps indicates the section of pipe line which is under the heaviest load, and the meter readings on the front of the device register other comparative values of pipe-line networks. Engineers are thus able to evaluate and interpret the results to determine construction or modification requirements.

Organizing Cost Reduction

(*Continued from page 554*)

are the elected or appointed representatives of the people and are sent to Washington to act in their interest."

ATTACKING EXTRAVAGANCE AND WASTE IN INDUSTRY

In attacking extravagance and waste in industry, we individuals—and the results are the combined accomplishments of individuals—have an inherent advantage over the individuals in government. Expenditures stem from appropriations and budgets in both cases—the expressed intention or authorization to spend money. In industry most of the expenditures are made in the expectation of an appropriate financial return—else there soon would be no industry, much less the phenomenal growth we have witnessed in the past 50 years. Industrial expenditures are almost measured by a micrometer scale—an incentive for cost reduction. Seldom do governmental expenditures anticipate any financial return. Governmental expenditures are not even measured by a yardstick—much less a micrometer scale. The incentive seems to be only to make ever-increasing expenditures. When we gripe or grouse over extravagant governmental expenditures always remember this—they can be made only when our representatives in Congress appropriate the money. They represent us and we elect them.

CONCLUSION

I have described and explained organized cost reduction as it is carried out in the du Pont engineering department. If any reader intends to organize cost reduction he will need to employ at least some part of each of the five prerequisites: (1) Management leadership and support; (2) indoctrination for participation by every person in the organization; (3) responsibility of line organization for accomplishment; (4) one or more capable young engineers, well trained for the job, to devote full-time training and assisting line organization; and (5) periodic financial and descriptive reports on accomplishments and goals, reviewed promptly by management with supervision and by supervision with all workers, recognizing good work, devising means to avoid repetition of any not-so-good work, and thus continually, through the exchange of ideas and experience, to seek new ways for cost reduction.

A final word of caution—don't become discouraged soon after organizing cost reduction. Du Pont made many cost reductions during the 100 years before the engineering department was established. The engineering service division of the engineering department made many cost reductions since its beginning, but only since all divisions were fully organized for cost reduction did we learn of the surprising results which can be accomplished—Try it!

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Metals Engineering

Axial Tension and Bending Interaction Curves for Members Loaded Inelastically, by D. O. Brush, and O. M. Sidebottom, Jun. ASME, University of Illinois, Urbana, Ill. 1952 ASME Semi-Annual Meeting paper No. 52—SA-6 (in type; to be published in Trans. ASME).

THIS paper presents a theoretical method for constructing dimensionless interaction curves for members subjected to combined tension and bending loads that produce inelastic strains, as well as experimental results which verify the theory. Each interaction curve represents the total range of the ratios of axial load to bending moment which will cause inelastic strains to extend to a given depth in the member. Experimental interaction curves were obtained from eccentrically loaded tension members of rectangular cross sections made from three strain-hardening materials, namely, annealed rail steel and aluminum alloys 24S-T4 and 75S-T6. Good agreement was found between theory and experiment. In order to design a member subjected to combined axial and bending loads by use of the interaction curves, the deflection of the member must be estimated. Three orders of approximation for the deflection of eccentrically loaded tension members are presented. The problem of combined bending and axial compressive loads is discussed and research based on the methods of analysis developed in this investigation is suggested for solving for the buckling load of a member subjected to combined bending and axial compressive loads.

The Influence of Aging on the Bauschinger Effect in Inelastically Strained Beams, by T. M. Elsesser, O. M. Sidebottom, Jun. ASME, and H. T. Corten, University of Illinois, Urbana, Ill. 1952 ASME Semi-Annual Meeting paper No. 52—SA-8 (in type; to be published in Trans. ASME).

IN many engineering applications the elastic-limit loads for members are increased by overloading the members until inelastic deformation occurs in regions of peak stresses. The extent of the inelastic deformation may be of the order of magnitude of the elastic-limit strain in such members as overstrained beams and autofrettaged thick-walled cylinders. An increase in the elastic-limit loads for these members is possible because of the beneficial macroscopic (measurable) residual stresses resulting from the inelastic deformation. However, the full theoretical beneficial effect of the residual stresses is never realized since they are reduced by the inelastic deformation caused by the Bauschinger effect which occurs when the member is unloaded. This investigation was undertaken to determine whether the full benefit of the macroscopic residual stresses could be retained by aging the member while loaded, and in this way eliminate the Bauschinger effect before its detrimental influence could occur. Tests were conducted on beams of rectangular cross section made from annealed mild (SAE 1020) and high-carbon (rail) steels. An aging treatment of 180 F for 20 hr was found to be sufficient to remove practically all of the Bauschinger effect in the mild steel but was not sufficient to remove all of the Bauschinger effect in the high-carbon steel.

The Effect of Slightly Elevated-Temperature Treatment Upon Microscopic and Submicroscopic Residual Stresses Induced by Small Inelastic Strains in Metals, by H. T. Corten and T. M. Elsesser, University of Illinois, Urbana, Ill. 1952 ASME Semi-Annual Meeting paper No. 52—SA-7 (in type; to be published in Trans. ASME).

INELASTIC deformation of metals introduces structural changes which during unloading and reversed loading cause the Bauschinger effect. This effect may be interpreted in terms of microscopic and submicroscopic residual stresses. A slightly elevated-temperature treatment applied to an overstrained tension specimen at zero load allows two mechanisms to occur, namely, (*a*) relaxation of microscopic residual shear stresses in slip bands, and (*b*) a reduction of submicroscopic residual forces around flaws and disordered regions by the place change of atoms. Each of these mechanisms, (*a*) and (*b*) partially or completely removes the Bauschinger effect. In brass and low-carbon steel, the

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application of a slightly elevated-temperature treatment at a high stress level, during which mechanism (*a*) does not occur, very nearly or completely removes the Bauschinger effect. It appears therefore that the removal of the Bauschinger effect can be attributed, under these conditions to mechanism (*b*). This fact means that in load-resisting members made of these metals and containing favorable macroscopic residual stresses induced by inelastic deformation, the undesirable microscopic and submicroscopic residual stresses which cause the Bauschinger effect may be removed, thereby retaining the full theoretical value of the favorable macroscopic residual stresses.

Railroads

Developments in Metallic Friction Draft Gears, by N. T. Olsen, Mem. ASME, Peerless Equipment Company, Chicago, Ill. 1952 ASME Semi-Annual Meeting paper No. **52—SA-27** (mimeographed).

EARLY draft attachments consisted of hooks and chains, providing for serial starting. Freight cars were designed to carry about four tons, and the car weighed more than the lading. Trains in that day consisted of about 10 cars and operated at about 10 mph. The first improvement in draft attachments was to install a spring between the hook and the car to prevent snapping the chains in pull, and later the arrangement was improved so that the hook became a coupler and the spring took care of both pulling and buffing forces.

With the use of larger cars and locomotives and corresponding train speeds, the perfection of the automatic coupler, the general use of air brakes, and the introduction of steel in construction of cars, it was very apparent that the service demands from the buffers were tremendously increased. The situation might be described by saying the general improvements in rolling equipment had been too fast for draft-gear development to keep up with them. The need was for a gear of more capacity than obtained with the plain spring that was generally used, and less recoil; therefore it was inevitable that the friction draft gear should appear in the picture.

The majority of present-day metallic friction draft gears utilize the friction between sliding surfaces to dissipate energy and a spring or combination of springs to store energy and transmit the steady load. The friction surfaces are usually arranged so that the frictional force is proportional to the spring force; that is, the force applied to the spring also provides the normal force between the sliding friction surfaces. When the spring is being compressed, the friction forces oppose the motion, thereby increasing the load necessary to compress the springs a given amount; and when the spring is being released the friction forces reverse and again oppose the motion, thereby decreasing the external load corresponding to a given spring compression.

A Method of Establishing and Comparing Tonnage Ratings of Diesel Locomotives, by E. H. Weston, Mem. ASME, Chicago and North Western Railway Company, Chicago, Ill. 1952 ASME Semi-Annual Meeting paper No. **52—SA-28** (mimeographed).

ALTHOUGH there are only four major builders of Diesel-electric locomotives for the American railroads, the types and models of engines being produced are far from standardized.

The design of engines and electrical equipment is in a continual state of flux. The intent of the changes in current designs are, mainly, twofold. First, there is a constant effort being made by the builders to provide more horsepower for each driving axle in order that train speeds may be increased. Second, there are the various researches being carried on to improve the amperage capacity of electrical equipment to strengthen hauling capacity of the locomotives.

Since many railroads through a steady year-by-year purchase of new Diesel-electric locomotives have reached or are about to reach saturation of the main-line requirements for Diesel motive power, more attention is being given to branch-line requirements. Each year more announcements are made by the builders of special low-axle loading machines suitable for light rail and light track structures. The six-axle six-motor type of 1600-hp road switch locomotive with a total weight around 290,000 lb, is the outstanding example of a current type of branch-line locomotive.

These same six-axle six-motor 1600-hp road switch locomotives are also being ballasted to 360,000 lb for heavy main-line drag service at low speed.

Also, two or three 1000-hp switching locomotives with special gear ratios are being multiplied for special types of heavy line drag service.

The impact of all of the foregoing types of Diesel-electric locomotives on the railroads has resulted in no little confusion as to just which type of locomotive is suitable for a certain service. Since railroad purchases of Diesel power have for the most part been made slowly at first and then more rapidly, each railroad has a number of different models of the same general type of locomotive from the same manufacturer. To add to the complexity of the situation, the operating people are given to understand that certain of these Diesel locomotives of the same horsepower cannot operate together in multiple on the same train because of differences in electrical equipment.

This paper attempts to solve the problem of handling all of the various types and makes of Diesel locomotives with regard to tonnage rating them for all subdivisions of all divisions.

Dynamic Testing of Freight Cars, by J. M. Roehm, Mem. ASME, Pullman-Standard Company, Hammond, Ind. 1952 ASME Semi-Annual Meeting paper No. **52—SA-41** (mimeographed).

RAILROADS today are making every effort to realize higher utilization of equipment. This seems to reflect itself in higher speed operations all down the line, including impact speeds in classification yards, the mean speed according to a statistical survey being around 7 mph. As a result of these increased speeds car structure and lading are being subjected to higher forces and a requirement exists for developing better draft gears and other types of cushioning devices to protect both the car body and its contents. Present draft gears are entirely inadequate for the amount of energy which they are required to absorb. The rubber cushion sliding center sill is a step in the right direction toward solving this problem. As long as free slack in a train, which limits draft-gear travel, is a problem which must be contended with, it appears that future trends will have to be along the lines of the sliding-center-sill car. By this means a reasonable amount of work can be obtained at a force level which will not cause damage.

There is also the possibility that hydraulics may enter the picture again although it has been tried unsuccessfully from the day of George Westinghouse up to the present time. Hydraulics offers, theoretically at least, the advantage of maintaining a constant force level throughout any given length of travel. Adequate horizontal cushioning appears to be the main problem facing the railroads today. Some progress has already been made toward solving this problem and within the next few years further progress can be expected. Improved draft gears used in connection with the other devices should go a long way toward improving conditions throughout the railroad industry.

Aviation Gas-Turbine Instruments

Instrumentation for Axial-Flow-Compressor Research, by C. A. Meyer, Jun. ASME, and R. P. Benedict, Westinghouse Electric Corporation, Philadelphia, Pa. 1952 ASME Annual Meeting paper No. 52—SA-18 (in type; to be published in Trans. ASME).

A DISCUSSION of many of the air-flow instruments currently used in compressor research is given. A history of the development of some of the instruments is presented together with the reasons for adopting the present designs. Optimum dimensions, based on test data, are included for claw probes, cylindrical probes, spherical probes, and averaging probes. Errors encountered in temperature measurement by means of thermocouples are reviewed, and methods for reducing these errors are suggested. A discussion of traversers is also included.

A Clearanceometer for Determining Blade-Tip Clearances of Axial-Flow Compressors, by A. W. Brunot, Mem. ASME, and R. O. Fulton, General Electric Company, West Lynn, Mass. 1952 ASME Semi-Annual Meeting paper No. 52—SA-16 (in type; to be published in Trans. ASME).

THIS paper covers the design and use of an instrument for determining blade-tip clearances of axial-flow compressors. The development of the measuring head and control circuits for operating the probe-type head and the results obtained from the use of this instrument are covered, with illustrations and graphs which show clearances in axial-flow compressors under various operating conditions.

The determination of operating clearances has enabled the design engineer to control the compressor clearances accurately by controlling factors which affect the clearances of an axial-flow compressor. Thus more efficient axial-flow compressors can be made by reducing the tip clearances under all operating conditions and still maintain some clearance to avoid rubbing.

The advantage of knowing the clearance of any axial-flow compressor under all conditions of operation is not yet a reality because the instrument in its present form is not readily adapted to flight testing owing to the power requirements and the auxiliary equipment required to operate the instrument.

This disadvantage of weight and power for flight-test information will be overcome in the future by a simpler system for measuring clearances. However, for accuracy and simplicity in test-cell operation this instrument does the work required, and the data which have been accumulated in numerous tests have proved the value of such an instrument.

Fast Thermocouples as Control-System Elements Sensing Exhaust-Gas Temperature in Aircraft Gas Turbines, by J. S. Alford and C. R. Heising, Jun. ASME, General Electric Company, Lockland, Ohio. 1952 ASME Semi-Annual Meeting paper No. 52—SA-35 (mimeographed).

A PRESENTATION is made of the factors which favor the use of thermocouples as control-system elements sensing exhaust-gas temperature in aircraft gas turbines. The development of a construction having adequate strength to withstand vibration is described. Analytic and experimental determinations of the time constant of thermocouples are presented. A mathematical analysis is presented of the effect on time constant of conduction along the thermocouple wire to the support. A discussion is included on the recovery factors of thermocouples. An evaluation is made of the error introduced when a number of thermocouples that read different temperatures are connected in parallel.

Conclusions reached by the authors are as follows:

1 Thermocouples have been developed to have adequate mechanical strength to withstand the severe vibration to which they are exposed in the gas stream.

2 The time-response rate is sufficiently rapid to permit their being used as practical control-system elements sensing exhaust temperature.

3 Thermocouples should be so located in the exhaust-gas system that the average reading is unaffected by changes in the amount of swirl in the hot exhaust gases discharged from the turbine.

4 Practical means are now available for connecting and amplifying the d-c voltage of the thermocouples so as to make them adaptable to control systems.

5 The hot junction can be extended a sufficient distance beyond the support base to eliminate any appreciable error due to axial conduction effects in the thermocouple wires.

6 Radial temperature gradients in the thermocouple wire are small enough to be ignored as a source of error.

Industrial Instruments

The Process Characteristics Which Affect Automatic Control, by J. B. McMahon, Mem. ASME, and R. A. Ackley, Mem. ASME, Republic Flow Meters Company, Chicago, Ill. 1952 ASME Semi-Annual Meeting paper No. 52—SA-3 (in type; to be published in Trans. ASME).

THE important process factors which affect the application of automatic control are discussed under three headings: (*a*) In the section for selection of criteria of process conditions, it is emphasized that the factors selected to represent process operating conditions must truly represent the conditions and bear a substantially linear relation to them. Discontinuities are to be avoided. (*b*) Self-regulation is a sustained reaction inherent in a process which assists or opposes the establishment of equilibrium. Its presence or absence may determine whether or not automatic control is practical. Typical examples are given. (*c*) Process lag is classified under six different types of common time reactions. A qualitative discussion points out which types of lag and lag combinations assist and which oppose good automatic-control results. The effect of automatic-control arrangement and regulator performance are brought out. Hydraulic examples of process-lag combinations are presented, with the corresponding reaction curves.

Automatic-Control Terminology, by Terminology Committee of the ASME Industrial Instruments and Regulators Division. 1952 ASME Semi-Annual Meeting paper No. 52—SA-29 (mimeographed).

THE need for a common language in the field of industrial process control was recognized when in February, 1946, the Terminology Committee of the Industrial Instruments and Regulators Division of ASME published its list of terms and definitions. Normal evolution requires that such terminology be revised in accordance with usage and changes in the technology. The growth in recent years of interest in this field, together with the activity in related fields, has accelerated the need for a revision of the original terminology. This process, of course, will continue as the technique of the related fields approaches more nearly that of the process-control engineer. It is with this thought in mind that the current revision of the Automatic Control Terms is prepared and submitted

to the membership of ASME for a second time.

Machine Design

High-Speed Surface-Broaching Machine, by E. C. Raehrs and E. J. Rivoira, Jun. ASME, Cincinnati Milling Machine Company, Cincinnati, Ohio. 1952 ASME Semi-Annual Meeting paper No. **52—SA-24** (mimeographed).

THIS paper describes in detail how a large machine, a Cincinnati horizontal two-way broach, capable of developing 450 hp, was designed to take full advantage of tungsten-carbide cutting tools, thus increasing the machine cutting speed from 37 to 200 fpm.

This machine, weighing approximately 90 tons, occupies a floor space of approximately 19 × 51 ft. When shipped, it was a full-capacity load for a 45-ft flatcar. The function of this machine is to rapidly remove a large amount of metal, from a securely held rough forging or casting, to an accurate surface finish in one pass of successive broaching tools.

The machine consists of the following units: (1) the bed, (2) reciprocating ram to carry the cutting tools past the work, (3) driving mechanism for reciprocating the ram, (4) work-holding fixture, (5) transfer mechanism and rollover, (6) frame and support for the elements, (7) tools, and (8) power plant.

The bed supports all of the elements and must handle all of the reactive forces. It is of all-welded construction approximately 6 ft wide, 7 ft high, and 36 ft long. The complete structure is reinforced to form uniform compartments using steel plates and box sections. The total weight of the bed unit is approximately 50,000 lb and is thoroughly stress-relieved.

Extensive use of fabrication was made in this machine. Experience shows that great economies can be realized by this method in small-lot production.

The Effects of Solid Inclusions in the Oil Supply to Sleeve Bearings, by H. Grady Rylander, Jun. ASME, The University of Texas, Austin, Tex. 1952 ASME Semi-Annual Meeting paper No. **52—SA-30** (mimeographed).

SLEEVE bearings operated under normal conditions are always subjected to some foreign solid particles in the oil supply. Internal-combustion engines produce solids in the combustion process; other particles are produced by wear; and others enter as dirt, rust, and scale from the air or piping. A thorough understanding of the operating characteristics of sleeve bearings when subjected to certain particles in the oil leads to an improved design of bearings, shafts, oil, and oil filters.

The problem of filtering out small particles below 10 microns in size is extremely difficult, and in the majority of applications only a small per cent of the oil-pump discharge is filtered. Even full-flow filters have by-pass arrangements to insure an oil supply to the bearings in the event the filter becomes clogged. Commercial automotive cartridge filters will not effectively remove particles below 8 microns and some will pass particles as large as 25 microns.

This paper describes an experimental investigation of lead-base babbitt bearings operating with oil containing solid particles of graphite, molybdenum sulphide, red rouge, and corundum. The operating characteristics of a bearing operating on clean oil are compared with the same bearing operating on oil containing varying particle concentrations and sizes. It was found that particles could vary the coefficient of friction, increase wear, increase the operating temperature, and change the oil-flow characteristics of a bearing.

Machine-Tool Lubrication, by J. R. Keen, American Steel Foundries, Cincinnati, Ohio, 1952 ASME Semi-Annual Meeting paper No. **52—SA-31** (mimeographed).

THE purchase of a machine tool from a reputable manufacturer insures against failure of machine function from the standpoint of design, material, and workmanship. However, interruption of production due to faulty lubrication is often overlooked by the purchaser as a possible hazard. The machine-tool manufacturer has discharged his responsibility in this respect when he makes provision for an adequate means of lubrication, and furnishes detailed instructions outlining the type, grade, and quality of the various lubricants and the proper location and frequency of their application. How closely these instructions are followed is dependent entirely upon the new owner's attitude toward the problem of successful machine-tool lubrication.

Very often the purchaser of a machine tool will be so interested in getting the machine into production that the machine will be started up and operated without even its initial lubrication which is normally checked by the service engineer who should have been called upon to start up the new equipment. Sometimes the customer will use cleaning compounds to remove rust inhibitors from the machine and then endeavor to move large heavy slides before any lubrication has been applied to these cleaned bearing surfaces.

Most mass-production industries with automatic or semiautomatic machine tools have been forced to install lubrication departments staffed with specialists in the art of lubrication, who carry on a periodic lubrication schedule of each machine in the plant, using the correct oils for each specified application. This is due to the fact that these industries hire machine operators who know little or nothing about complicated mechanisms. These lubrication departments more than pay for themselves in protection of the plants' capital assets and prevention of production tie-ups necessitated by replacement of burnt-up and improperly lubricated machine parts. Smaller shops usually employ a higher class of machine operator or machinist who is more familiar with the proper maintenance of machine tools, and thus the need for a specialized lubrication department is not nearly so critical, but is still very desirable.

If all machine-tool users would insist on a definite lubrication program, following the machine-tool builders' charts and recommendations, establish and maintain a segregated area for the storage of lubricants and the prevention of their contamination, there would be no lubrication problem.

Production Engineering

Report of an Investigation of the Strain Hardening Effect Upon Subsequent Levels Due to Metal Cutting, by C. L. Sonnenschein, Jun. ASME, and W. P. Wallace, Mem. ASME, University of California, Los Angeles, Calif. 1952 ASME Semi-Annual Meeting paper No. **52—SA-25** (mimeographed).

THIS paper presents experimental results of increase of hardness of base metal as a function of depth of cut for a given cutting speed, from which an analytical expression of the form $H = CD^n$ may be written. Attempts have been made to correlate the resulting hardness with the finish and chip type produced. The hardness measurements were made with the 15-N Rockwell tester and were verified, qualitatively and quantitatively, by use of x-ray diffraction techniques.

Samples of SAE 1020 steel, $^3/_{16} \times 3 \times 6$ in., were machined for squareness and then annealed to remove all stresses due

to rolling and machining. A nominal cut of 0.005 in. was made on one sample, 0.010 in. on a second, and 0.015 in., 0.020 in. and 0.025 in. on the others. The cuts were made parallel to the direction of rolling on the $^{3}/_{16}$-in. surface using a planer. The cutting tool was high-speed tool steel ground to a 14-deg rake angle; this value was a constant for all tests. Three cutting speeds of 40, 82, and 125 fpm, were used. Hardness tests, using Superficial 15-N, were made before and after each cut. A minimum of ten readings were obtained for each sample.

Relative Abrasiveness of the Cast Surfaces of Various Gray-Iron Castings on Single-Point Tools of High-Speed Steel, by Joseph Datsko and O. W. Boston, Fellow ASME, University of Michigan, Ann Arbor, Mich. 1952 ASME Semi-Annual Meeting paper No. 52—SA-17 (in type; to be published in Trans. ASME).

THIS study reveals that plain gray-iron castings made in sand molds have a very abrasive surface that results in a low tool life when machining the surface. This condition can be eliminated almost completely by pickling the castings prior to machining. Annealing improves the machinability of the casting, but it also results in a more pronounced "skin effect." By means of an annealing and pickling treatment, the cutting speed for removing the surface was increased by 230 per cent.

Fuels

A Study of Burner Oscillations of the Organ-Pipe Type, by A. A. Putnam, Jun. ASME, and W. R. Dennis, Battelle Memorial Institute, Columbus, Ohio. 1952 ASME Semi-Annual Meeting paper No. 52—SA-12 (in type; to be published in Trans. ASME).

THREE simplified combustion systems have been investigated for acoustical oscillations. The systems are: (*a*) a mixing chamber and multiple-port burner mounted in a combustion tube open at both ends; (*b*) a similar mixing chamber and multiple-port burner which completely blocked the secondary-air inlet of the combustion tube; and (*c*) a system similar to (*b*) but utilizing separate fuel and primary-air inlets, giving a diffusion flame rather than a premixed-gas flame. Oscillations were found to occur only for certain ranges of the variables. In the first system, the pitch differed significantly in adjacent ranges of oscillation. In the two latter systems, the frequency of the oscillations remained fairly uniform and close to the fundamental of the combustion tube, although breaks occurred in the data as the configurations of the inlet supply systems were varied. These results are explained on the basis of (*a*) the time of feedback of pressure pulses which ultimately cause changes in the heat-release rate, and (*b*) the location of the flame relative to a section of maximum pressure amplitude in the combustion tube. In further substantiation of the implications of the test results, the Appendix presents a thermodynamic treatment of the phase requirement between rate of heat release and pressure.

Applied Mechanics

The Concept of Complex Damping, by N. O. Myklestad, Mem. ASME, University of Illinois, Urbana, Ill. 1952 ASME Applied Mechanics Division Conference paper No. 52—APM-15 (in type; to be published in the *Journal of Applied Mechanics*).

IN this paper it is shown that if the hysteresis loop for a material has a particular shape the damping can be considered adequately by multiplying the modulus of elasticity of the material by the complex number e^{2bi} where $2b$ is called the complex damping factor. For small values of b it is shown that both for free and forced vibrations of a simple spring-mass system the motion in the case of complex damping is the same as in the case of viscous damping, with $b = c/c_{cr}$, except that in the steady-state case the phase angles are slightly different. Also, it is shown how complex damping may be applied to cases of forced vibrations of uniform rods and beams. The greatest advantage of using complex damping, however, is in numerical calculations of forced vibrations of engine crankshafts, airplane wings, and other types of structures; and for such calculations it already has been extensively used.

The Free Oscillation of the Centrifugal Pendulum With Wide Angles, by F. R. E. Crossley, Mem. ASME, Yale University, New Haven, Conn. 1952 ASME Applied Mechanics Division Conference paper No. 52—APM-17 (in type; to be published in the *Journal of Applied Mechanics*).

THE pendulum torsional vibration absorber, designed usually in the bifilar form, has proved very effective in its purpose, especially in radial aircraft engines. The ordinary theory is based on an assumption of small angles of swing of the pendulum, and this assumption simplifies the equations of motion to linear form. However, wide angles of swing have actually been observed in most installations. Two previous analyses have been made of the wide angle swing, but have shown only the usual lengthening of the period due to wide swing of a gravity-controlled pendulum. Here it is demonstrated that the longer period due to wide angles will be offset by taking a heavier pendulum on a given carrier, for this shortens the period tremendously.

Bending Vibrations of a Pipe Line Containing Flowing Fluid, by G. W. Housner, California Institute of Technology, Pasadena, Calif. 1952 ASME Applied Mechanics Division Conference paper No. 52—APM-3 (in type; to be published in the *Journal of Applied Mechanics*).

BOTH free vibrations and forced motions due to crosswinds may create important problems in the design of pipe lines supported above ground. An analytic investigation, based on simple beam theory, shows that the flow of fluid in such a pipe line has no beneficial effect upon the vibrations. The fluid velocity causes a dynamic coupling of the simple modes of vibration so that the normal modes of vibration are of complex shape with 90-deg out-of-phase components. The solution is presented for free vibrations and for steady-state forced vibrations, and it is shown that large amplitudes may be developed if the amount of damping is too small. It is shown that at low fluid velocities there is negligible effect upon the vibration of the pipe line, and at a certain high critical velocity the fluid flow causes a dynamic instability. The present analysis revises the conclusions which appeared in an earlier publication.

A Study of Vanes Singing in Water, by C. A. Gongwer, Mem. ASME, Aerojet Engineering Corporation, Azusa, Calif. 1952 ASME Applied Mechanics Division Conference paper No. 52—APM-33 (in type; to be published in the *Journal of Applied Mechanics*).

IN the course of propulsion experiments in the ring-channel and rotating-boom facility at the Aerojet Engineering Corporation, it was discovered that certain struts which are used to support underwater bodies would "sing" at surprisingly low speeds, e.g., 5 to 7 knots. Tail surfaces also sang. The note emitted was a clear musical tone in most instances, and, as the speed was

increased, the note would fade, disappear, and then reappear as a note of higher frequency. This singing caused considerable apprehension as it was feared that the strut would fail at high speeds due to build-up of the vibrations. Analysis for flutter stability and torsional divergence had been conducted, and it was known that the operation was well away from the ranges where flutter or torsional divergence might occur. However, the severity of the singing did not tend to become greater at high speeds, and there were usually quiet speed zones at high speeds as well as at low speeds.

A Mathematical Analysis of the Relaxation Type of Vehicle Suspension, by Joseph Gallagher and Enrico Volterra, Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-13** (in type; to be published in the *Journal of Applied Mechanics*).

THE responses of the relaxation type of vehicle suspension to steady and transient disturbances are analyzed. The results are compared with the corresponding responses for the standard type of vehicle suspension. The relaxation suspension system shows a definite improvement over the standard suspension system in the response to transient disturbances, as the initial shocks following a sudden wheel movement are reduced greatly. In the particular case of critical adjustment of a relaxation suspension system the maximum amplitude of the transient vibration is approximately 30 per cent lower than that of the standard-type system at critical adjustment. The amplitude and phase-angle curves presented in the paper for the steady-state motion, together with the transient-state-response analysis, permit the design of a relaxation-type suspension system with known vibrational characteristics in both states.

Forced Lateral Vibration of Beam Carrying a Concentrated Mass, by W. H. Hoppmann, 2nd, Mem. ASME, The Johns Hopkins University, Baltimore, Md. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-20** (in type; to be published in the *Journal of Applied Mechanics*).

IN this paper a study is made of the problem of the lateral vibration of a simply supported beam with a concentrated mass attached at its mid-point. A force assumed to act at the mass in a direction normal to the length of the beam is represented by a sinusoidally time-varying function. The homogeneous form of the Bernoulli-Euler beam equation is solved considering the problem as one with time-dependent boundary conditions. To represent an important case of forced vibrations the solution is transformed to give the deflection and bending strain caused by a pulse type of load. Curves are plotted whereby the contributions to deflection and strain from the higher modes of vibration may be examined as functions of the ratio of attached mass to mass of beam. Results of computations for a specific beam and set of masses are presented, as well as experimental results for the same beam with similar pulse-type loads applied. Oscillograms show rather trenchantly the slow transition of the mass-beam system toward a one-degree-of-freedom system as the concentrated mass is increased.

Large Plastic Deformations of Beams Under Transverse Impact, by E. H. Lee, Mem. ASME, and P. S. Symonds, Mem. ASME, Brown University, Providence, R. I. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-21** (in type; to be published in the *Journal of Applied Mechanics*).

A COMPARATIVELY simple method of analysis is developed to determine the deformations in a beam subjected to lateral impact of such a magnitude that plastic strains, large compared with elastic strains, occur. A useful approximation to the motion then can be obtained by neglecting elastic strains and considering rigid-body motion of segments of the beam joined at plastic hinges where the entire deformation takes place. A method of analyzing such a situation is described and applied to a beam subjected to central impact. The approximate final permanent deformation is obtained; this includes deformation during application of the load, and plastic flow which continues afterward when the kinetic energy of the motion generated by the impact is transformed into additional plastic deformation. A criterion is given for conditions when this type of theory can be expected to provide a satisfactory analysis. The method of solution provides an interesting analogy to the concept of static determinacy which has been used in the analysis of quasi-static plastic-flow problems.

Free Vibrations of Constrained Beams, by Winston F. Z. Lee, and Edward Saibel, Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-31** (in type; to be published in the *Journal of Applied Mechanics*).

A GENERAL expression is developed from which the frequency equation for the vibration of a constrained beam with any combination of intermediate elastic or rigid supports, concentrated masses, and sprung masses can be found readily. The method also is extended to the case where the constraint is a continuous elastic foundation or uniformly distributed load of any length. This method requires only the knowledge of the natural frequencies and natural modes of the beam supported at the ends in the same manner as the constrained beam but not subjected to any of the constraints between the ends. The frequency equation is obtained easily and can be solved to any desired degree of approximation for any number of modes of vibration in a quick and simple manner. Numerical examples are given.

ASME Transactions for June, 1952

THE June, 1952, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers) contains:

Partially Plastic Thick-Walled Cylinder Theory, by M. C. Steele. (51—A-25)

On the Stresses in a Notched Strip, by Chih-Bing Ling. (52—APM-5)

An Alternative Formulation of the Laws of Mechanics, by H. M. Trent. (51—A-30)

A Variational Principle for the Mesh-Type Analysis of a Mechanical System, by R. A. Toupin. (51—A-19)

The Limit Design of a Transversely Loaded Square Grid, by Jacques Heyman. (52—APM-2)

Heat-Exchanger Tube-Sheet Design—2, Fixed Tube Sheets, by K. A. Gardner. (51—A-38)

Bending and Buckling of an Elastically Restrained Circular Plate, by H. Reismann. (52—APM-7)

Gas Cooling of a Porous Heat Source, by Leon Green, Jr. (51—A-32)

The Marcus Method Applied to Solution of Uniformly Loaded and Clamped Rectangular Plate Subjected to Forces in Its Plane, by C. C. Chang and H. D. Conway. (52—APM-1)

Measurement of Recovery Factors and Friction Coefficients for Supersonic Flow of Air in a Tube, Part 2—Results Based on a Two-Dimensional-Flow Model For Entrance Region, by J. Kaye, T. Y. Toong, and R. H. Shoulberg. (51—A-29b)

Lateral Vibrations as Related to Structural Stability, by Harold Lurie.

Bending Vibrations of a Pipe Line, Flowing Fluid, by G. W. Housner. (52—APM-3)

Heat Conduction in a Compressible Fluid, by J. D. Cole, and T. Y. Wu.

The Computation of Flexural-Torsional Buckling Loads, by H. F. Michielsen.

Torsional Vibration Modes of Tapered Bars, by H. E. Fettis.

Analysis of Elastic 2 and 3-Section Short Columns, by C. M. Tyler, Jr. and F. Z. Lee.

Bending of Orthotropic Beams, by H. D. Conway.

Energy of Bending of Plates, by H. L. Langhaar.

BOOK REVIEWS

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Modern Reheat Turbines

COMMENT BY EDWIN H. KRIEG[1]

This paper[2] is a most valuable addition to the small group of papers that a power engineer keeps for ready and continual reference. The authors deserve our sincere appreciation.

Considerable attention was given by the authors to the overspeeding of the Sporn low-pressure turbine upon failure of the intercept valves to close completely.

This brings to mind the dump valves which were installed by the writer on the reheat lines to the low-pressure elements of a 165,000-kw turbine at Philo. After several years of operation, when it was found that it would not only be costly but also would require an extensive outage to correct the large amount of steam leakage possible around the periphery of the intercept valves, which were of the butterfly type, installation of dump valves proved a positive and economical second line of defense against intercept-valve leakage. In a current paper M. K. Drewry[3] indicates that intercept valves are entirely eliminated on Port Washington unit No. 5, and replaced by dump valves. However, the other Port Washington units have dump valves as a backup to the intercept valves.

In connection with Fig. 6 of the paper, showing the Public Service Electric and Gas Company of New Jersey turbine, is it possible for the authors to reconcile the lightweight truss in the side exhaust opening with the usual 5-ft-wide and 7-ft-deep heavy reinforced-concrete beam that is ordinarily provided at such a location? The writer has often thought that the heavy concrete side beams might be eliminated in bottom exhaust turbines by incorporating a built-up steel girder in the turbine exhaust itself, in cases where the condenser is supported on springs. Of course, such construction probably could not be used for a turbine having an expansion joint in the condenser neck because of the heavy vacuum loading. This possibility of decreasing the cost of concrete foundations of bottom exhaust units might be worth while.

COMMENT BY H. R. REESE[4]

The authors have presented an excellent review of their service experience with modern reheat units of the past 2 years together with the description of recent design features proposed for the new reheat units. The successful operation of modern reheat turbines and the ease with which difficulties presented in this paper have been corrected must be gratifying to the utility industry.

It was interesting to note the performance of the speed-governing system on the Dunkirk unit. We do not expect the speed of a reheat turbine on loss of load to reach as high an overspeed as nonreheat units, since the high-pressure steam is bottled up in the high-pressure turbine and reheater by the interceptor valve. The faster the interceptor valve is closed the less will be the increase in speed.

On units manufactured by the writer's company, the interceptor valve is closed when speed reaches 102.5 per cent. Also, the steam stored in the reheater is dissipated at the same speed.

Although we have had iron-oxide deposits on throttle and governor-valve stems, until now none of the throttle or interceptor valves has stuck. We agree with the authors that two throttle and two interceptor valves should be provided so that each one can be closed fully while carrying load. The writer's company always has provided two throttles and two interceptor valves on all reheat units. Two throttle valves have been provided on all nonreheat units 40,000 kw and larger for the past 10 years. Both the throttle and interceptor valves are provided with stem-sealing features with large clearances between the stem and bushing. The valve disk is protected from the main steam flow by a skirt.

We agree with the authors' recommendation and strongly urge blowing down the boiler, main-steam and reheater lines prior to starting.

It has been our practice to recommend nonreturn valves in extraction lines for all feedwater heaters above atmospheric pressure. For reheat units we have not insisted on a nonreturn valve for the feedwater heater at the reheat point, since the interceptor valve would bottle up the steam stored in the reheater and feedwater heater. Should the purchaser feel the need of extra protection, we would have no objection to his supplying a nonreturn valve as suggested by the authors.

The exhaust temperature of reheat units during starting and light-load operation has been a subject of many discussions. We note the need of desuperheating sprays in the crossover to control overheating of the exhaust during starting and light-load operation. On reheat units of the writer's company using 20 and 23-in-long last row blades, excessive exhaust temperatures have not been experienced. With low absolute pressure the reheat units have been operated for long periods at no-load holding saturation temperature corresponding to the back pressure. A by-pass valve is provided by the writer's company to control the exhaust temperature in case it should exceed 250 F. The by-pass valve also can be used to by-pass the reheater while water or caustic washing the turbine.

For starting, we recommend a good vacuum 15 to 20 in. Hg to keep exhaust temperatures down. To insure this, we urge the purchaser to provide large priming ejectors. The additional cost for this feature is very small.

With double-wall construction on units supplied by the writer's company, the slip-type expansion joints between the inlet pipes and the inner case have been free of trouble. The slip joint is made up of a number of concentric rings similar to those used on automobile-engine pistons.

[1] Consulting Engineer, Stone & Webster Engineering Corporation, Boston, Mass. Fellow ASME.

[2] "Modern Reheat Turbines—Service Experience and Recent Design Progress," by Carl Schabtach and Raymond Sheppard, MECHANICAL ENGINEERING, vol. 74, February, 1952, pp. 107–114.

[3] "Reheat Experience at Port Washington," by M. K. Drewry, Trans. ASME vol. 74, 1952, pp. 551–556.

[4] Assistant Manager, Thermodynamic Section, Land Turbine Engineering, Steam Division, Westinghouse Electric Corporation, Philadelphia, Pa. Mem. ASME.

In general, we agree with the starting and loading procedure. There is a tendency today to start unit-type boiler-turbine units with inlet pressures around 100 psig. Although we have no objection to this low pressure, we favor starting with 300 to 400 psig because this provides more stable conditions.

On the recent design progress, we note with interest the use of double-wall construction below the reheat point. This has been standard practice on all reheat units manufactured by the writer's company, in order to confine the high reheat temperature to a small area and reduce temperature gradient over the outer wall.

We agree with the present practice of using ferritic materials for cylinders, pipes, and valve bodies up to 1050 F, although we would feel better about it if we had 10 years of experience.

Many of the design features of the higher capacities, pressures, and temperatures are the same or similar to those covered in a paper by R. L. Reynolds,[5] such as, the triple-flow exhaust with opposed flow for the high-pressure and intermediate-pressure elements which reduces dummy sizes materially. The thrust bearing is located between the high and intermediate-pressure cylinders.

Locating the interceptor valves on top of the intermediate cylinder several stages below the reheat return increases the size of the valve and requires two large pipes to the cylinder cover where large flanges will have to be dismantled to lift the cover. We do not anticipate any particular stress problems on the design interceptor valves for 1050 F and reheat pressures in the order of 400 to 600 psig.

We agree with the authors that the cross-compound arrangement has the disadvantage of higher initial cost and greater complexity of operation. The writer's company for more than 20 years has advocated the single-shaft high-speed turbine because of its economic and operating advantages. We have spent a great deal of time and effort developing it and promoting its use.

COMMENT BY C. D. WILSON[6]

We have not yet encountered anything that could be identified as the iron-oxide build-up on the stems of stop and control valves which is reported in the paper to have been encountered in several new installations. However, we have observed, in a few cases after short periods of initial operation, a reduction in packing clearance of between 0.001 in. and 0.002 in. which appears to be due to a scale deposit or surface growth. Therefore we have increased our packing clearances to compensate for this.

On stop valves and intercepting valves, this can be done without increased leakage losses because the packing glands on these valves are provided with back-seated valve stems. On governor-controlled inlet valves we use the leakage steam to seal the steam-sealed glands on the main shafts so that a slight increase in valve-stem leakage is not objectionable.

The reliable operation of the intercepting valves on reheat machines is in the same order of importance as the reliable operation of the main stop valve.

For this reason, on current machines, we are using the same operating cylinder and trip arrangement as well as the same back-seated valve-stem backing on both of these important valves. In addition, the intercepting valve has a modulating feature which makes its opening and closing a function of governor speed.

For a number of years now, as a precautionary measure, we have been providing cooling sprays in the exhaust hoods of our larger-size turbines. These sprays are available if they should be needed to control the exhaust-end temperature. With the steam-sealed glands which have been used on all of our new designs since about 1945, it is possible to build up the vacuum in the exhaust at the beginning of the starting cycle. Our experience to date has indicated that if adequate vacuum is maintained in the exhaust it is seldom necessary to use the sprays.

AUTHORS' CLOSURE

The authors wish to thank the discussers for their numerous comments serving to amplify and emphasize the material presented in this paper. It appears that many of the reheat turbine-design features developed by the authors' company are widely accepted.

Mr. Krieg suggests that a lightweight truss be provided along the sides of exhaust casings, to permit decreasing the depth and cost of the foundation beams in those cases where the condenser is supported on springs. This could be done but it would greatly complicate the design and construction and increase the cost of the exhaust casing, and it appears to the authors that the necessary strength can be provided more simply and inexpensively in the foundation. Aside from this, the deep continuous beams forming the top of the foundation constitute a desirably rigid tabletop which serves to distribute the load uniformly among the several supporting columns and to minimize differences in vertical misalignment at the several points of support for the turbine-generator bearings.

Mr. Krieg's application of dump valves to the 165,000-kw cross-compound unit at Philo needs a little further explanation, since their function is basically different from that of the dump valves at Port Washington, as described by Mr. Drewry. At Philo, the reheat line to each low-pressure turbine contained two intercept valves in series. These valves were double-disk type with 24-in. diam seats originally designed with 0.031 in. radial clearance between the disk and the seat. In other words, the disks did not contact either of the seats and the consequent leakage through the valves when in their closed position was in excess of the no-load steam flow. The dump valve mentioned by Mr. Krieg was connected between the two intercept valves so as to blow this section of the line down to atmosphere when the intercept valves closed. The 6-in. atmospheric dump valve does not accomplish a second line of defense in case the two intercept valves should fail to close, since it is of insufficient size to by-pass an appreciable portion of the stored steam in the reheater. The peak speed reached, should the intercept valves fail to close, will be lowered somewhat by the presence of this 6-in. dump valve, but the maximum speed will still be far above the 110 per cent trip speed of the emergency governor.

In reply to Mr. Reese's comments concerning the relative speed of reheat and nonreheat units following load dump, the maximum speed of a reheat unit upon loss of full load may be greater or less than that of a nonreheat unit, depending upon the rapidity of closing of the intercept valves and the amount of steam stored between the intercept valves and the following section of the turbine. The location of the intercept valves on the turbine shell minimizes the quantity of such steam which remains uncontrolled no matter how fast the intercept valves are closed. One reason for locating the two intercept valves on the upper shell of the reheat section where possible is to reduce this stored volume to a minimum. Fig. 5 is an illustration of the intercept valves placed directly on the upper shell of the reheat section. Simi-

[5] "Recent Development of the Reheat Steam Turbine," by R. L. Reynolds, MECHANICAL ENGINEERING, vol. 74, January, 1952, pp. 9–14.

[6] Engineer-in-Charge of Steam Turbine Design, Steam Turbine Section, Power Department, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Mem. ASME.

larly, locating the intercept valves on the top of the intermediate cylinder several stages below the reheat return, enables the valves to trap the additional steam volume in the crossover pipes to the intermediate section. In the case of a cross-compound unit with the intermediate section on the 1800-rpm shaft, this crossover volume may be a very significant factor with respect to catching the unit before the 110 per cent trip speed is reached, depending upon the crossover pressure.

The provision of two throttle valves mentioned by Mr. Reese does not appear equally necessary to the provision of two intercept valves. The throttle or stop valves, together with the control valves, constitute a double line of defense at the initial steam admission. Daily operation of the control valves, plus a weekly partial closure test of the stop valve, has been demonstrated by many years of experience on hundreds of turbines to provide adequate warning of malfunctioning. Since the stem-sealed stop-valve construction was introduced 10 years ago, there has been no case in which stop and control valves both failed to operate in emergencies. Consequently, two stop valves are provided only for turbines larger than about 100,000-kw capacity, where steam flow, pressure drop, and valve-body design considerations indicate a need for them. We note that Mr. Reese similarly uses a single throttle valve on nonreheat units smaller than 40,000 kw.

The differences noted by Messrs. Wilson, Reese, and the authors in reheat turbine-exhaust-temperature characteristics are rather puzzling. It seems scarcely possible that these can be explained by differences in condenser vacuum or in the low-pressure turbine proportions, no load losses, or other characteristics of the turbine-generator set. Possibly the explanation lies in a difference in boiler characteristics, particularly in the temperature of the reheated steam at light loads.

The need for some means by which to cool the exhaust during no-load operation of reheat turbines with 23-in-long last-stage buckets has been firmly established by our experience; perhaps the accumulation of additional experience by others will serve to clarify the reasons for the difference. By-passing the reheater at light loads to reduce turbine-exhaust temperature has the disadvantage of reducing the steam flow through the reheater, which tends to cause overheating in this section of the boiler.

Regarding Mr. Wilson's comment that the deposits on valve stems appear, from his experience, to be associated with scaling or surface growth, there seems to be strong evidence in our experience to the contrary. Austenitic stems which are highly resistant to oxidation at 1050 F have been found in several cases to have accumulated iron-oxide deposits during the initial period of operation. Further, deposits identical with those on the stems have been found on the Stellite inserts in the valve disks and valve seats.

These Stellite inserts do not oxidize in a few months' time at 1050 F. The deposits both on austenitic and ferritic stems appear to occur mostly during the first few months' of operation, and do not continue to reappear after they have been removed once or twice, as would be expected if they resulted from oxidation of the stems.

CARL SCHABTACH.[7]
RAYMOND SHEPPARD.[7]

[7] General Electric Company, Schenectady, N. Y.

The Reheat Steam Turbine

COMMENT BY EDWIN H. KRIEG[8]

We are grateful indeed for this valuable addition to the existing lore on the reheat cycle and the reheat steam turbines.[9]

The well-developed list of advantages of the reheat cycle might well include an additional major advantage, namely, reheat has helped make it possible to rate 3600-rpm turbines up to 185 mw.

Seven different arrangements for reheat turbines are shown and it would be interesting to know how so many variations can be justified in view of the trend to keep turbine-generator costs lower by standardization.

In connection with the sticking of valves due to valve-stem deposits sometimes known as "blue blush," has the author any thoughts on why and how loose iron-oxide powder becomes a hard adherent scale on valve stems that even a file cannot remove? It would seem that this mechanism might be a worth-while subject of investigation.

COMMENT BY CHARLES D. WILSON[10]

This paper indicates that there is now a definite trend toward reheat-type machines in sizes larger than about 60-mw capability and our experience confirms this trend. In our current production, 50 per cent of machines having 75-mw capability are designed for reheat and, in the sizes of approximately 100-mw capability and larger, 100 per cent of the machines are designed for reheat. Steam conditions for these reheat machines range between 1450 psi, 1000 F — 1000 F and 1800 psi, 1050 F — 1000 F, with the majority of the machines at 1800 psi, 1000 F — 1000 F.

The arrangements of reheat turbines described in the paper cover most of the types now being used. In arrangements D and F, in which the steam flows of the high-pressure and intermediate-pressure turbines are opposed, the paper states that the blade thrusts also can be opposed to reduce the size of the balance pistons. This certainly is a definite advantage for the reasons given in the paper. It should be pointed out, however, that the balance-piston design must still consider the possibility of abnormal closing of the intercepting valves and the balance pistons must be designed to avoid serious overloading of the thrust bearing for this abnormal condition. One advantage of the opposed-flow-type construction which is not mentioned in the paper is that this design also minimizes the differential expansions between cylinders and spindles during quick starting or sudden load changes.

The writer's company is now building several machines similar to arrangement F in the paper. One advantage of this cross-compound arrangement is that it lends itself to an extremely compact design if the intermediate-pressure exhaust is located to discharge through a short side connection directly into the center of the double-flow low-pressure turbine. The floor area of a 120,000-kw unit arranged in this way occupies a space 44 ft wide and 77 ft long, and a similar 150,000-kw unit would occupy a pace only slightly larger.

AUTHOR'S CLOSURE

Mr. Krieg raises an important point regarding the possibility of extending the capability of 3600 rpm units by the use of the reheat cycle. A reduction in exhaust steam flow of 15 to 18 per cent and in exhaust volume of 7 to 8 per cent permits the extension of triple exhaust 3600-rpm capabilities to 200 mw.

The number of arrangements used on

[8] Consulting Engineer, Stone & Webster Engineering Corporation, Boston, Mass. Fellow ASME.

[9] "Recent Development of the Reheat Steam Turbine," by R. L. Reynolds, MECHANICAL ENGINEERING, vol. 74, January, 1952, pp. 9–14.

[10] Engineer-in-Charge of Steam Turbine Design, Steam Turbine Section, Power Department, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

reheat turbines has been somewhat of a development problem. However, these conditions have now become more stabilized with the result that nearly all the reheat turbines are of two types, arrangement B for double-flow exhaust ends, and arrangement D for triple-flow exhaust ends.

The deposition of hard magnetic iron oxide on valve stems of high-temperature units is now being investigated by several operating companies. It is felt that this material comes from the boiler, steam piping, or condenser shell. We have not determined the mechanism which transforms this powder to a hard adherent scale, but agree with Mr. Krieg that further investigation is worth while.

Mr. Wilson also raises the important point of protecting against excessive thrust bearing loads in case of abnormal closing of the interceptor valves. Provision has been made to provide ample relief area in the dummy leakoff lines to prevent excessive thrust bearing loading when the interceptor valves close.

R. L. REYNOLDS.[11]

[11] Manager, Central Station Turbine Section, Westinghouse Electric Corporation, South Philadelphia Works, Lester, Pa. Mem. ASME.

A New Industrial Revolution

TO THE EDITOR:

A new industrial revolution, equally as potent as the mass-production revolution of sixty years ago, has quietly but consistently been developing in our machine shops, offices, laboratories, and executive chambers during recent years. This industrial revolution, which is showing signs of having even greater national influence than the first one, is the realization by industry of its responsibilities to its employees and is evidenced by widespread interest in, and application of, the principles of human relations.

Industry can no longer afford to be the autocratic, indifferent empire of business and profits for it has become an institution. Industry has grown to a new level in our society and is on a par with the home, the church, and the school. As an institution, as well as a social motivating force, industry has acquired a responsibility to its communities and citizens.

Its contribution today rests on assuming the responsibility for helping to satisfy the needs of those citizens who work for industry.

Industrial leaders, foremen, personnel directors, and supervisors are learning to work together in attempting to satisfy human needs through the mediums of communication, recognition, benefits, and employee services.

Communication up-the-line as well as down-the-line is becoming more a practice than an idea. Group conferences are helping to create true channels for communication. Company manuals and newspapers are finding favor in more and more firms and are aiding in developing communication.

Greater recognition is being given to employees at all levels by such items as awards for faithful service, attractive job titles, quota contests, idea suggestion systems, and by emphasis on the importance of recognition to supervisors in training programs.

Industrial benefits have been widened to include free insurance, hospitalization protection, retirement plans, hazard pay for special assignments, extra compensation for overtime work, rest periods, and job security.

More and more employee services are being provided to make the work environment more pleasant. Such services as credit unions, vending machines, recreational facilities, and parking lots are becoming the rule rather than the exception.

Indeed, the practice of human relations in our industries today and every day will result in more effective use of our human resources than ever before, for the good of our communities, our industries, and the citizen-employee himself.

JOHN B. CLARK.[12]

Technical Literature

TO THE EDITOR:

There is needed some objective handling of the large volume of technical literature now being produced. We are learning the facts about many of the new things that are being discovered and developed. Much of the technical literature is written in the form of news. When written as news it is often handled by the typical news gatherer and unless this is understood, such news may be misleading, even though obtained by a scientist.

The next publicity is presented in the form of a technical paper bearing on a theory, a discovery, or test data presuming to prove a theory or discovery. This requires very careful checking and should be written only after exhaustive tests have been made and not a come-by-chance test or idea.

The engineering profession was originally divided into two systems, that of Military and Civil Engineering. What was Civil Engineering has now been listed in many divisions such as, Civil, Mechanical, Electrical, Mining, Metallurgical, Aeronautical, Marine, and many others.

In 1924 I desired to discover how reliable the technical literature was at that time. It was conceived that if certain well-established facts about history of engineering processes were traced backward to their inception, it might give a clue to the probable reliability of the then current technical literature. It was thought if the proceedings of, say, one of the oldest technical societies were studied it would reveal the general percentage of reliability if the true facts were available as a standard of measurement.

The proceedings of the Royal Society of England were used for this purpose, and since these proceedings go back to the year 1665, it involved a considerable amount of time and could only be done with a few fundamental subjects. Four subjects used by engineers were selected and the following general outline was established to divide the literature into two divisions:

(*a*) That which could be read by a student of the subject with reliability and which would not mislead him into speculative and unprofitable considerations.

(*b*) That which contained a considerable amount of truth, but also a large amount of fancy. A student might be led into a labyrinth of speculation which would use up much of his time in an unprofitable effort.

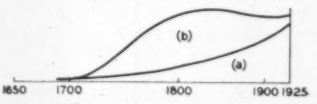


FIG. 1

The result of this study is shown in Fig. 1 which indicates the division between (*a*) and (*b*).

The upper line represents the total of that which was published on the four subjects. The lower line encompasses that under item (*a*). It is believed that there is a significance in the shape of these two curves. I believe that the hump in the upper curve indicates the desire of a certain number of the contributors for publicity in what might be

[12] Minneapolis, Minn. Jun. Mem. ASME.

called a good subject. The steady climb of the lower curve represents steady work of reliable investigators who are really the builders of our fundamental knowledge. I have drawn the curves eliminating the unevenness which appeared because the facts I wish to convey were so clearly indicated by the two curves as drawn. Each point from which the two curves were drawn is the accumulated writings of ten years on these subjects in the proceedings. The quantity was established by the number of pages of written matter.

I believe that our voluminous technical writings could be very greatly reduced and improved if the technical societies and magazines printing them could make a logical effort to screen out some of the transitory and highly speculative material now printed. I do not mean that speculation by those who do a large amount of precision work is not valuable when so labeled. Even reliable negative work is valuable but is very rarely printed and should be given some of the space now occupied by (*b*).

You will ask, how may I become acquainted with a reliable investigator? In answer to this I will tell you what I did for myself. It was very apparent from the study mentioned of all that Kelvin wrote as Thomson and later as Lord Kelvin, that he did not write much at first. When he did write, it was apparent that his writings were the result of much work and much consideration of this work. From this I coined the saying that "He who says much knows little, and he who knows much says little." I do not know how true this may be, but hard work and diligent consideration must go before great success. I believe that there is no substitute for it, but even so, not all who work hard are assured of success.

What I have shown in a simple diagram as covering about 250 years, I am sure at the present writing will be covered in 50 years or less for the newer discoveries, because there are so many more scientific and technical men working to discover the answers to our problems. We can, therefore, get the answers more quickly, but also we can make more and greater mistakes if care is not taken.

T. MCLEAN JASPER.[13]

[13] Milwaukee, Wis. Mem. ASME.

Unity in the Engineering Profession

TO THE EDITOR:

In the interests of real unity in the engineering profession may I be allowed to submit the following thoughts for consideration?

I have been a member through all grades, and continuously since college, of one of our larger technical societies. I have also been a state section president and contributed to committees and publications. It should be evident then that I am not interested in sabotaging the value of our technical societies.

However, to many of us the crying need of engineers today is one paramount society that will truly represent all qualified engineers both professionally and technically at local, national, and international levels. It should be an integrated society, and not merely a banding together of existing societies into a federation which neither represents all qualified engineers nor permits direct and democratic election of officers and directors by the individual members.

Many of us in the grass roots are disappointed in the four unity plans (A, B, C, D) so far proposed and would like to see at least one other plan considered. We are also disappointed that the individual members have had little or no opportunity to study all plans, compromises, or worthy minority ideas.

Apparently the Exploratory Group, in its report of December, 1950, expected individual members to have ample opportunity to express their ideas on unity. This does not seem to have been done generally and many of us feel that we are being forced to consider plans that could be improved for the benefit of engineers. I have written the Exploratory Group on this and suggested that each individual member of at least the 15 national societies that make up the Exploratory Group be polled to learn his wishes after he has had ample opportunity to study all plans, compromises, and worthy minority ideas. Among the last there is an admirable plan (called Plan E) that has been submitted by the Florida Section of ASCE. Unless engineers can be sure of what they want there will always be dissatisfaction and disunity.

At a very recent regional meeting of the American Society for Engineering Education, at which I spoke on the unity situation, I was surprised to learn of the vital interest this large group of engineering educators had in the subject; of their almost unanimous dissatisfaction with the Plans A, B, C, and D; and their desire for more information and a better integrated plan to consider. A resolution was passed unanimously to that effect and forwarded to the national ASEE secretary. It turned out that only five out of the group had seen or heard much about the four plans before my talk. They were also keenly interested in having a plan that would be a real integration of technical and professional interests and one in which the individual could vote directly for its officers and directors.

I am interested in real unity and not further disunity. I intend to support wholeheartedly a plan that the majority of engineers favor. Some of us want to be sure, however, that engineers have adequate opportunity to express their wishes on the plan they want. Such can hardly be done without a poll, or if they are told it must be one of the four plans or nothing.

T. H. EVANS.[14]

[EDITOR'S NOTE: The Report of the Exploratory Group to Consider the Increased Unity of the Engineering Profession, adopted Dec. 15, 1951, which was published with the minority report in full in MECHANICAL ENGINEERING, March, 1952, states: "Thirty-three hundred copies of this report (of Dec. 16, 1950, in which four plans, A, B, C, and D, were presented for study and discussion) have been distributed among the officers and other representatives of the 15 societies finally constituting the Exploratory Group. It has been the basis for wide discussion during the past twelve months. . . . On Sept. 28, 1951, the Exploratory Group received from its members oral reports of the results of these discussions."

The American Society of Mechanical Engineers and MECHANICAL ENGINEERING provided the machinery for full consideration of the report to ASME members and urged expressions of opinions and preference. The 1950 report was widely circulated by ASME for free discussion at meetings of Sections and at Regional Administrative Committee meetings and by the Regional Delegates at the 1951 Semi-Annual Meeting at Toronto. The recommendation of the Regional Delegates approving Plan A, modified, was accepted by the Council at the Toronto Meeting. All these matters were reported in MECHANICAL ENGINEERING, which also carried, throughout 1951, a summary, with organization diagrams, of the four plans proposed in the 1950 Report, a President's letter urging study of and views on the report, editorials on the subject, and many news items relating thereto.]

[14] Dean of Engineering, Colorado Agricultural and Mechanical College, Fort Collins, Colo.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Extrusion

EXTRUSION OF PLASTICS, RUBBER, AND METALS. By H. R. Simonds, A. J. Weith, and William Schack. Reinhold Publishing Corp., New York, N. Y., 1952. Cloth, 5¾ × 9 in., tables, figs., appendix, index, ix and 454 pp., $10.

REVIEWED BY A. G. GIFFORD[1]

SELDOM has a more complete study of a manufacturing technique been compiled into one small volume. The authors have thoroughly covered a process of manufacture employed in operations as simple and familiar as the meat grinder, or as complex and up to date as the manufacture of aircraft propellers. The study includes the history, economics, and theoretical aspects of extrusion processes, and is as practical as a hand tool, in its detailed coverage of materials, equipment, processes, design, instrumentation, and applications. So wide is its scope and so complete its coverage, that the book should appeal to the factory foreman as well as production and design engineers, or management.

About 80 per cent of the text is devoted to the extrusion of plastics, with the remainder assigned to rubber, metals, and miscellaneous materials. The authors point out that "wide application of a given material often comes only after the technique of fabrication has been perfected." Extrusion, a relatively new processing technique in the plastics industry, is expected to produce greater tonnage than either molding or laminating.

Part 1, "Extrusion of Plastics," considers the selection of materials now being extruded on a commercial scale. It covers in detail the recommended processes for each material, including compound conditioning, handling, costs and advantages, extruder zone temperatures, and postdie handling. Careful attention is given to die and screw design, speed of extrusion, breaker plate, and screen design. Methods for obtaining special effects, multicolor extrusion, blow-molding, thermosetting materials, and curved extrusions are discussed. Tube splitting and spreading, and sheeting dies are described. British and German processes are included.

The thoroughness with which the authors have examined their field is shown by their detailed discussion of such items as the most suitable materials for extruder cylinder liners, effects of plating on screws, dies, and other components. Also included are tables of the many problems encountered in extrusion, with possible reasons for rejects and suggested solutions. Further explanation is made available through the use of graphs, charts, detailed drawings, and photographs.

Since the basic principles of extrusion are covered in part 1, part 2, assigned to rubber, metals, and miscellaneous materials, is devoted chiefly to a discussion of the peculiarities of the materials involved. The chapter on extrusion of rubber adds little to previously published literature.

The reviewer takes exception to the authors' comments on silicone rubber, in which they state that final curing, "at 400 to 480 F for 36 to 48 hours, develops the maximum strength properties of the compound." This is contrary to data published by both major suppliers of silicone rubber and obtained by our own laboratory, and is believed to be incorrect.

The history and development of the extrusion of metals and the modern practice of impact extrusion should be of particular interest to mechanical engineers.

The section on miscellaneous materials includes the extrusion of carbon, ceramic materials, catalysts, wood waste, foods, cosmetics, glass, and ice.

[1] Development Engineer, Lord Manufacturing Company, Erie, Pa. Jun. ASME.

Personnel Administration

READINGS IN PERSONNEL ADMINISTRATION. Edited by Paul Pigors and C. A. Myers. McGraw-Hill Book Company, Inc., New York, N. Y.; Toronto, Ont., Can.; London, England, 1952. Cloth, 5¾ × 9 in., author and subject indexes, xii and 483 pp., $4.50.

REVIEWED BY ERCOLE ROSA, JR.[2]

BY BRINGING together 46 of the outstanding papers on various aspects of human relations, Professors Pigors and Myers, of M.I.T., have performed a great service for the busy engineer, who though primarily concerned with his technical competence realizes the importance of having a sound understanding of the human-relations aspect of management and supervision. Increasing numbers of engineers are being given important management responsibilities involving the supervision of large numbers of people. For those engineers who are facing managerial responsibilities for the first time and for those who have regretted the need for consulting numerous publications to find the basic statements concerning personnel administration, this book under review will prove a useful reference.

The editors have selected articles written by such outstanding men as F. J. Roethlisberger, Ordway Tead, Alexander Heron, and William Gomberg. These papers cover the whole span of personnel administration including the foreman and his problems, building and maintaining effective work teams, wages and work assignments, and employee services. In addition to the careful selection of papers, the effective organization and continuity of the presentation represents an important contribution by the authors. The result is a book which will suit the needs of those engineers who want to become familiar with the fundamental thinking of personnel administration as a guide for effective handling of the many problems involving human relations which arise every day in industry.

Much of the value of the material presented is due to the philosophy underlying the area of personnel administration which is developed upon the following six points:

1 Personnel administration is management because it is getting results through and with people.

2 In order to carry out a program of personnel administration, leaders at all organization levels need to understand

[2] Instructor, Industrial-Engineering Department, Columbia University, New York, N. Y. Jun. ASME.

how organizational parts and wholes are related.

3 In personnel administration, the foreman is a key man.

4 Relationships within each small group should be characterized by team spirit.

5 One way in which management can encourage team spirit is to develop a sound wage and salary structure.

6 Nowhere is the personnel point of view more needed than in integrating two matters that are commonly treated as separate or even conflicting goals: meeting the human problems of the employees and the production problems of management.

Each of these six basic propositions is supported by numerous papers, many of them classics, drawn from a total of 32 different publications. Specific techniques are not so much emphasized as are fundamental policy considerations. The combination of a sound approach and an effective organization of outstanding contributions makes this an extremely useful book.

Let us hope that this book will lead the way for similar books covering other areas with which the engineer must come into contact as a leader and manager.

Books Received in Library

AIR POLLUTION. Proceedings of the United States Technical Conference on Air Pollution. Sponsored by the Interdepartmental Committee on Air Pollution, Louis C. McCabe, Chairman. McGraw-Hill Book Company, Inc., New York, N. Y., 1952. Bound, 7 1/2 × 10 in., 847 pp., charts, illus., graphs, tables, diagrams, $12.50. Nearly 100 papers were presented at this 1950 technical conference by authorities from the government services, research organizations, and industry. In order to co-ordinate the information effectively, seven panels were established as follows: air pollution in relation to agriculture; analytical methods and properties; equipment for the collection or prevention of formation of contaminants; health considerations; instrumentation for size and concentration determinations; legislation; meteorological aspects.

ALL-PURPOSE DIESELS. By J. Malcolm Robson. Sir Isaac Pitman and Sons, Ltd., London, England, 1951. Bound, 6 1/4 × 9 1/4 in., 313 pp., illus., tables, diagrams, charts, $10. A comprehensive technical survey of the design and practical applications of Diesel power units. Particular attention is given to the many practical uses of oil engines because such requirements have a material effect on engine layout and appearance. Several chapters deal with the development of oil engines and with the equipment for their starting, cooling, governing, and power transmission.

AMERICAN PIPE LINES. By George S. Wolbert, Jr., University of Oklahoma Press, Norman, Oklahoma, first edition, 1952. Bound, 7 × 10 1/2 in., 179 pp., $3.50. A thorough effort to present and analyze the salient factors involved in the economic and regulatory status of pipe lines. In two parts, the book opens with a report on the historical, economic, and technical development of pipe lines, including a discussion of the specific issues relating to industry rate and service requirements. The second part surveys existing legal and administrative remedies designed to cope with the problems described in Part 1. The influence of the ICC is examined carefully.

CENTRALI ELETTRICHE. By Mario Mainardis. Editore Uirico Hoepli, Milan, Italy, second edition, 1952. Paper, 7 × 10 in., 705 pp., diagrams, charts, illus., tables, 3500 lire. A comprehensive treatise on central stations covering both hydro and steam power generation. In each case the general plant, the major machinery, and auxiliary equipment are dealt with in detail. Subsequent chapters treat the electrical machinery, regulating and protective equipment, insulating materials and devices, dimensions, economics, and standards.

COMPLÉMENTS D'HYDRAULIQUE. By L. Escande. Part 1, Eduard Privat, Toulouse, 1947. Paper, 7 1/2 × 9 1/2 in., 220 pp., charts, illus., tables, 1500 fr. Part 2, Dunod, Paris, France, 1951. Bound, 9 × 11 in., 248 pp., illus., charts, tables, 3900 fr. These two volumes contain the published accounts of various researches in the field of hydraulics. Among the topics considered are the following: flow in open channels; hydraulic models and similitude problems; the operation of hydraulic valves and gates; water hammer and surge chambers, including graphical methods for the solution of problems; and a variety of detailed analyses of special hydraulic conditions.

DÉFAUTS DE FONDERIE. By François Boussard. Dunod, Editor, Paris, France, 1952. Paper, 6 × 9 1/2 in., 424 pp., diagrams, charts, tables, 2700 fr. Seventy-two examples of foundry defects are dealt with in detail under eight headings broadly classified according to the cause: shrinkage, metal imperfections, gas formation, sand difficulties, metal pressure, and so on. In each case the formation, appearance, specific cause, and remedy are described. Extensive tables are appended providing a classification of defects by appearance, a listing of effective precautions, and an international numerical classification for indexing defects.

EXTRUSION OF PLASTICS, RUBBER AND METALS. By Herbert R. Simonds, Archie J. Weith, and William Schack. Reinhold Publishing Corporation, New York, N. Y., 1952. Bound, 6 1/4 × 9 in., 454 pp., tables, illus., diagrams, charts, $10. This book deals with extrusion as an important processing operation. Some three fourths of the book is devoted to extrusion in the plastics industry, covering materials, equipment, methods, die design, instrumentation, and special problems in connection with the extrusion of shapes, tubes, sheets, films, and coatings. The remainder of the book covers the extrusion of metals, rubber, and miscellaneous materials, and provides a glossary and a brief buyers' guide.

FACTORY PLANNING AND PLANT LAYOUT. By William Grant Ireson. Prentice-Hall, Inc., New York, N. Y., 1952. Bound, 6 × 8 1/2 in., 385 pp., tables, diagrams, illus., $7.35. This well-illustrated text is an industrial engineering approach to factory planning from the standpoint of economical production of the commodity involved. The needs of production, subassembly, and final-assembly lines are discussed, as well as the layout of various departments, factory services, buildings, and personnel facilities.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

FARM POWER. By Ben D. Moses and Kenneth R. Frost. John Wiley and Sons, Inc., New York, N. Y., 1952. Bound, 6 × 9 1/4 in., 484 pp., tables, diagrams, illus., graphs, $5.75. Beginning with a discussion of the relation of farm power to agriculture, this textbook presents its technical information in two succeeding major sections. Part 2 deals with the internal-combustion engine: principles of the Otto and Diesel-cycle engines, parts, accessories, troubles, types, and operation. Part 3, covering the farm tractor, includes discussion of tractor types, field requirements, economics, selection, operation, testing, attachments, maintenance, and repairs.

FOUNDRY PRACTICE. By William H. Salmon and Eric N. Simons. Pitman Publishing Corporation, New York, N. Y., 1951. Bound, 5 3/4 × 9 3/4 in., 384 pp., illus., diagrams, tables, charts, $6.50. A comprehensive practical guide which covers the field from the blueprint to quality control, including patterns, molding and core-making, pouring, and molten metal, the cast metal, and heat-treatment. The material is so arranged, including extensive question-and-answer sections, that it is suitable for a textbook, particularly designed for gaining a British certificate. There is a considerable bibliography.

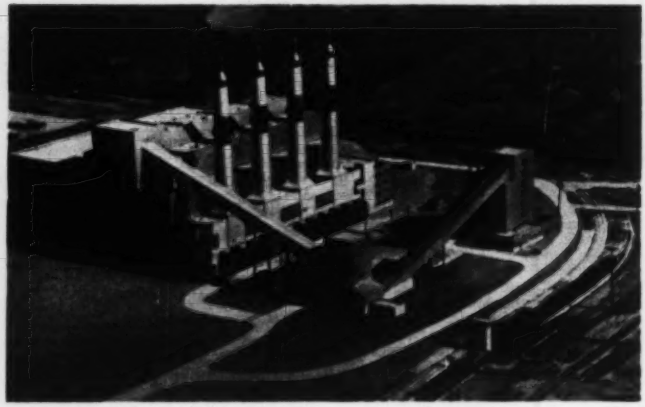
FUNDAMENTALS OF TOP MANAGEMENT. By Ralph Currier Davis. Harper & Brothers, New York, N. Y., 1951. Bound, 5 3/4 × 8 1/2 in., 825 pp., charts, tables, $6. A handbook for executives and students of management, this comprehensive work on business organization presents objectives, policies, and general methods governing the solution of basic business problems. Among the problems of executive leadership and scientific management considered are line and staff organizations, organizational morale, control of operations, and business procedures. Detailed information is given on all aspects, and solutions are reviewed that have been successfully applied.

HEATING, VENTILATING, AIR CONDITIONING GUIDE, 1952. Vol. 30. American Society of Heating and Ventilating Engineers, New York, N. Y., 1952. Bound, 6 1/2 × 9 1/4 in., 1496 pp., illus., tables, charts, diagrams, $7.50. A standard reference book; its fifty chapters are devoted to such varied topics as the fundamentals of thermodynamics, the physiological bases of heating and air conditioning, the calculation of heating and cooling loads of enclosed spaces, and to descriptions of systems and apparatus such as steam-heating systems, panel heating, electric heating, refrigeration, and drying systems. The numerous changes in this new edition are listed in the preface. There is a large indexed section of condensed manufacturers' catalogs.

ASME NEWS

With Notes on the Engineering Profession

1952 ASME Fall Meeting in Chicago



NEW RIDGELAND STATION OF COMMONWEALTH EDISON COMPANY, CHICAGO, ILL., ONE OF THE WORLD'S MOST POWERFUL GENERATING STATIONS. CHICAGO WILL BE THE SCENE OF THE CENTENNIAL OF ENGINEERING, SEPT. 3–13, 1952, AND THE ASME FALL MEETING, WITH HEADQUARTERS AT THE SHERATON HOTEL, SEPT. 8–11

Centennial of Engineering

Plans for Foreign Participation Announced

DECISION of the Mutual Security Agency at Washington to utilize the importance of the Centennial of Engineering, scheduled in Chicago, Ill., Sept. 3–13, 1952, to bring 200 leading European engineers to the United States to study American production methods, was announced.

The foreign group is expected to arrive in the United States well in advance of the official opening of the big engineering-society convocation part of the Centennial program. During the convocation, more than 50 leading American and foreign engineering societies will co-operate in a 10-day program of joint meetings covering all important aspects of engineering and the many fields it serves.

Present plans call for the foreign visitors to spend at least five weeks in this country. They will also participate in a special two-day productivity seminar now tentatively arranged at the Museum of Science and Industry on August 31 and September 1. At the seminar, discussions will be led by outstanding American engineering authorities. The Museum is headquarters for the Centennial and will be the scene of most of its major activities, some of which will begin early in July.

Following participation in the Centennial convocation, the foreign group will tour America's leading cities and production centers as well as other areas with key engineering installations. Main objectives will be to give them every possible opportunity to observe American methods of design, construction, and operation of engineering works, mass production, and distribution, and the roles of engineers, labor, and management in the productivity of the United States.

Actual supervision of the foreign engineering visitation will be under the direction of the National Management Council, serving as an agent for the Mutual Security Agency.

The number of American engineering societies and associations pledged to take part in the Centennial has now reached 61, including The American Society of Mechanical Engineers, which will hold its Fall Meeting at the Sheraton Hotel, Sept. 8–11. They have a combined membership of almost 350,000 professional engineers covering practically every technical and scientific field. Prominent in shaping the program and other activities for these various participating groups are former president Herbert Hoover, Hon. Mem. ASME, and Charles F. Kettering, Fellow ASME, world leader in engineering research.

The largest single delegation announced so far will come from the Engineering Society of Norway. It will have 17 members. The Royal Society of Industrial Engineers, Belgium, will have an 11-man delegation; while the combined group representing Great Britain's Institution of Electrical Engineers, Institution of Civil Engineers, and The Institution of Mechanical Engineers is also expected to show large proportions. The British electrical engineers will be headed by Sir John Hacking.

Dr. Takeo Fukuda, of Tokyo University and vice-president elect of the Japan Society of Civil Engineers, will head his nation's delegation. France has chosen George Darrieus, president of its Society of Civil Engineers and member of the French Academy of Science, to lead its national group which will also include members of other French technical bodies.

Other countries with assured representations from among their leading scientists and engineers are The Netherlands, Switzerland, Italy, India, Canada, Mexico, Cuba, Peru, and Uruguay.

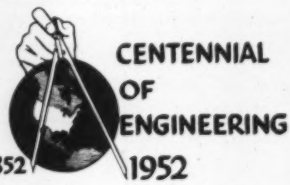
Variety of Technical Papers Presented at 1952 ASME Semi-Annual Meeting

THE 1952 Semi-Annual Meeting of The American Society of Mechanical Engineers was held at the Sheraton-Gibson Hotel, Cincinnati, Ohio, June 15–19.

In addition to numerous scheduled luncons, dinners, and inspection trips, a comprehensive technical program covering a wide variety of mechanical-engineering subjects was offered. Thirteen digests of the papers were published in MECHANICAL ENGINEERING, June issue, pages 503–507. In this issue 17 digests can be found on pages 589 through 593.

Subjects covered include gas-turbine power, industrial instruments, lubrication, heat transfer, railroad, petroleum, fuels, hydraulics, cutting fluids, metals engineering, aviation gas-turbine instruments, machine design, and production engineering. The remaining papers will be digested in forthcoming issues.

An account of the Semi-Annual Meeting will be published in the August issue.



U. S. and Latin Engineers Plan New Orleans Meeting

THE third convention of UPADI (Pan-American Federation of Engineering Societies) will be held in New Orleans, La., Aug. 25–30, 1952. Latest reports indicate that the meeting will attract approximately 200 engineers representing the professional societies throughout Central and South America. The site and time were chosen to permit the Latin delegates to participate in the observances commemorating the Centennial of Engineering.

UPADI is a relatively new organization. It was formed to provide a common meeting ground for Western Hemisphere engineers, a means to discuss mutual problems, and an opportunity to exchange ideas and information. ASME takes part in its activities through Engineers Joint Council.

The first UPADI Congress was held in Rio de Janeiro, Brazil, in July, 1949. Almost all Latin societies attended, and EJC sent official observers. At the meeting a number of papers were presented and a provisional constitution drawn up. This document was negotiated and revised during the period following the congress. At a convention in Havana, Cuba, in April, 1951, UPADI was formally constituted. Shortly thereafter EJC signified its adherence to the organization.

Program High Lights

The third convention in New Orleans will consider further revisions in the Constitution and adopt a set of by-laws. A technical program will be held on August 26. Its theme will be engineering education. The program is being developed by Leo J. Lassalle, Mem. ASME, dean, college of engineering, Louisiana State University. The general philosophy of engineering education will be explored together with post-graduate training of engineers. Problems and plans for expansion in this field will also be discussed. Two papers prepared by Latin delegates will be presented during the morning session. In the afternoon papers on the situation in the United States and Canada will be delivered.

While a good part of the Convention will be devoted to organization and business, arrangements have been made to inspect the facilities of the Port of New Orleans and visit plants in the vicinity. Various social affairs are scheduled including a formal banquet on August 29th. A program for the ladies is also being planned.

Meetings at Tulane

The Convention will meet at Tulane University where living quarters have been provided for the delegates. Air-conditioned McAlister Auditorium will be the center of the Convention activities. Spanish-English interpreters will be on hand to take care of the convention proceedings. A special UPADI Committee under the chairmanship of James M. Todd has set up various subcommittees to handle details of the convention. Each local section of the Founder Societies has a member on these committees.

The President of UPADI is Luis Giannattasio of Montevideo, Uruguay. He will serve through 1954. James M. Todd, past-president, ASME, chairman of the special UPADI Committee and in charge of arrangements for the New Orleans meeting, is vice-president. Manuel J. Puente of Havana, Cuba, is treasurer. Representatives of societies in Argentina, Brazil, Canada, Colombia, El Salvador, and Honduras make up the board of directors.

A cordial invitation is extended to all engineers to attend the various sessions. See MECHANICAL ENGINEERING, June, 1952, page 529, for the tentative program of the UPADI convention.

AIR VIEW OF THE WHARVES ON THE EAST BANK OF THE MISSISSIPPI RIVER AT NEW ORLEANS, LA. THIS TYPE OF DOCKING WITH THE SHIPS PARALLEL WITH THE WHARVES ALLOWS FOR MAXIMUM EFFICIENCY IN SHIPLOADING OPERATIONS. NEW ORLEANS WILL BE THE SITE OF THE THIRD UPADI CONGRESS, AUG. 25–30, 1952

Dante Cavalli of Italy Named Rice Scholar

DANTE CAVALLI, of Italy, was named 1952 Calvin W. Rice Memorial Scholar. Born in Tortona, Alessandria, Italy, he is 26 years old. He received a BME degree when he was graduated from the University of Genoa. Following his graduation he was an instructor in mathematics and physics. His post-graduate course consisted of work in iron and steel at the Institute of Genoa, followed by practical experience in the iron and steel industry of Italy. In addition to this experience he has done consulting work with the Italian Ministry of Industry. In June of 1951, Mr. Cavalli was assigned as assistant to the group of American experts of the Stanford Research Institute which, as a consulting team for the Italian Ministry of Industry, is completing a survey of conditions in the Italian mechanical industry after having inspected over 100 plants. He hopes to study industrial-engineering subjects in addition to his study program in internal-combustion engines and automotive engineering.

ISO Holds Meeting at Columbia University

Large Standardization Conference Held in U. S.

A TOTAL of 185 delegates from 25 nations, meeting at Columbia University in the opening ceremonies of the largest international standardization conference ever held in this country, on Monday June 9, 1952, heard Roger E. Gay, president of the American Standards Association, predict that far greater progress in the techniques of standardization will be made in the next 50 years than has been accomplished in the first half of this century.

Speaking to the International Organization for Standardization (ISO), Mr. Gay declared, "The frontiers for progress in international standardization are limitless. I confidently predict that all of us will emerge from these assemblies with a new respect for each other's work, and with a greater realization that we are just beginning."

The American Standards Association, U. S. member of ISO and host throughout the two weeks of sessions, has accredited 251 U. S. delegates to participate in the standardization work of the 15 ISO technical committees and subcommittees which will meet, making the total participation in the conference 436 delegates from 26 countries.

It was pointed out that this was the first meeting of its kind held in this country since 1926, the year in which the first nongovernmental international standards body was formed.

The delegates from the 25 national standards organizations were welcomed to the city by A. E. Robert Friedman, Deputy Commissioner of Commerce for the City of New York, serving as Mayor Impellitieri's representative. Dr. George B. Pegram, Fellow ASME, vice-president emeritus of Columbia University, spoke on behalf of Columbia.

Admiral George F. Hussey, speaking on behalf of ASA, assured the visitors of their seeing typical sights in New York during their stay.

In the absence from the welcoming luncheon of M. Albert Caquot, president of ISO, the guests were welcomed for the Organization by Dr. Lal C. Verman, director of the Indian Standards Institution and vice-president of ISO. Dr. Verman spoke briefly on the organization of ISO, its founding, accomplishments, and the like. He also paid a special tribute to ASA, to Columbia University, and to the government of New York City for making the meeting possible.

The British Standards Institution sent the largest foreign delegation. Its 37 members were headed by S. J. Harley, chairman and managing director, Coventry Gauge and Tool Company, Ltd., and H. A. R. Binney, director of the British Standards Institution, London.

Second largest delegation came from France, which sent 24 men headed by Albert Caquot, who is now concluding a three-year term as president of the International Organization for Standardization. Mr. Caquot is also president of the French Standards Association (AFNOR).

Included among the other French delegates were General Pierre Salmon, Commissioner of Standardization in the Ministry of Industry and Commerce, General Jean Pierre Nicolau, director, Superior Institute of Materials and Mechanical Construction, Jean Birlé, director of the French Standards Association. All are from Paris.

Germany's 21-man delegation was headed by Dr. Arthur Zinzen, managing director of the German Standards Association, Berlin.

ROGER E. GAY, PRESIDENT, ASA, WELCOMING DELEGATES FROM 25 COUNTRIES TO ISO MEETINGS HELD IN NEW YORK, N. Y.

(*Left to right:* Dr. Lal Verman, director of the Indian Standards Institution; Mr. Gay; Dr. George B. Pegram, Fellow ASME, vice-president emeritus of Columbia University, where the meetings were held; and Howard Coonley, Assoc. ASME, past-president ISO.)

Canada sent 17 delegates headed by Col. W. R. McCaffrey, general manager of the Canadian Standards Association, Ottawa.

Other nations which sent more than one delegate to the ISO meetings were Austria (2), Belgium (7), Denmark (5), Finland (2), India (9), Italy (8), Netherlands (8), Norway (2), Spain (8), Sweden (8), Switzerland (9), Union of Soviet Socialist Republics (5), and Yugoslavia (3).

Australia, Ireland, Israel, New Zealand, Portugal, Union of South Africa, Brazil, and Pakistan, were represented by one delegate each.

The ISO meetings opened at Columbia University on Monday, June 9, and ran through June 21. Fifteen ISO technical committees and subcommittees met to work on international standardization in the fields of iron and steel, cinematography, preferred numbers, mica, petroleum products, machine tools, limits and fits, textiles, lac, screw threads, ball and roller bearings, and standard marks.

A total of 76 ISO technical committees and 40 subcommittees are working on international standardization projects in various fields ranging from shipbuilding details for ocean-going ships to transfusion equipment for medical use.

ASME Region VIII Third Annual Meeting Held in Denver, Colo.

REGION VIII of the ASME held its third annual meeting in Denver, Colo., April 28–30, 1952. The technical sessions were preceded by a business meeting of the Regional Administrative Committee at which Harry P. Pearson, head of personnel department of the Dallas Power & Light Company, was selected as nominee for the office of vice-president, Region VIII, to succeed retiring vice-president C. J. Eckhardt.

The registered attendance for the meeting totaled 232 members, guests, and students. The student attendance was composed of the Rocky Mountain Tier, Region VIII, ASME Student Conference which met in joint session with the regular meeting. Each ASME student branch of the engineering schools of Colorado, Wyoming, and New Mexico was represented by a student who presented a paper in competition for prize awards. The papers in the order given were: "Industrial Methods of Testing Automobile Fuel Economy," Gerald W. Norris, Jr., University of Colorado; "The Discovery and Mining and Refining of Potash," Robert N. Richards, New Mexico A&MA; "Design of Fractionation Topping Tower," Jakob Grynberg, Colorado School of Mines; "Gas Turbines for Automotive Transportation," William Gilbert, University of Wyoming; "The Development of the Modern Milking Machine," James R. Mondt, University of Denver; "Concepts of Oil-Well Acidizing," Robert H. Graham, University of New Mexico; "The Free-Piston Diesel," Stephen Luchter, Colorado A&M College.

Judges of the student papers were F. H. Prouty, J. Y. Parce, and L. B. Card. Those who listened to the student papers presented agreed all were excellent and well presented. Winners of the competition were as follows:

First, Jakob Grynberg; second, Stephen Buchter; third, William Gilbert; fourth, Robert H. Graham. An additional award known as the "Old Guard Prize" was made to Gerald W. Norris, Jr.

Senior papers presented at the meeting were as follows: "Industry's Role in Training Engineers for Tomorrow," H. R. Pearson, Dallas Power & Light Company, Dallas, Texas; "Oil Fog Lubrication," D. G. Faust, chief engineer, C. A. Norgren Company, Englewood, Colo.; "The Production of Sugar From Beets," F. M. Sabine, general superintendent, American Crystal Sugar Company, Denver, Colo.; "Welding Controls, Inspections, and Tests for Large Steel Pipes," P. J. Bier, head, Penstock Section, U. S. Bureau of Reclamation, Denver, Colo.; "Some Considerations in the Construction and Operation of High-Pressure Offshore Gas Pipe Lines," M. P. Watson, United Gas Pipe Line Company, New Orleans, La.; "Deionization, Its Practical Aspects for Hard-Water Supplies," T. C. Hoppe and R. A. Russell, Black and Veatch, consulting engineers, Kansas City, Mo.; "An Improved Schlieren Apparatus, Employing Multiple-Slit Gratings," T. A. Mortensen, research engineer, Midwest Research Institute, Kansas City, Mo.

The annual banquet, held on April 28, was presided over by Frank Prouty with Chancellor Albert C. Jacobs as the featured speaker. Chancellor Jacobs spoke on the need and opportunity for technical and industrial development.

Inspection trips to Gates Rubber Company on April 29, and to the Reclamation Engineering Center on April 30, were well attended and special trips to the Denver Mountain Parks were arranged for the benefit of the out-of-town members and their wives.

Caution in Recalling Reserves Urged Upon Senate Armed Services Committee

IN a letter to Senator Russell B. Long (D. La.) made public on June 6, 1952, Carey H. Brown, chairman of the Engineering Manpower Commission of Engineers Joint Council, again pressed for the adoption of an amendment to the Armed Forces Reserve Act which would provide for the "screening of reserve recalls by an agency outside of the Department of Defense, specifically the Selective Service System."

The recommended amendment was argued for at the recent hearings before a Subcommittee of the Committee on Armed Services, U. S. Senate, in connection with the Armed Forces Reserve Act of 1951. And it embodied a plea, in the interests of the national economy, for civilian control in recalling reservists to active duty, when the reservist possessed a specialized skill that was in critically short supply.

Representatives of the Department of Defense and the three services hit the recommended amendment by saying that it is impractical and costly administratively to supply duplicate records to the Selective Service System.

The Engineering Manpower Commission of Engineers Joint Council, representing a large segment of the engineering profession and five other interests representing professional and industrial groups also suffering manpower shortages, generally concurred at the Senatorial hearings that the military status of those in short supply should be a secondary consideration when it comes to the question of where a man's skill can be most advantageously utilized.

At the hearings were representatives who were in general agreement with EMC proposals. They were from the Congress of Industrial Organizations, National Association of Manufacturers, American Chemical Society, American Institute of Physics, and National Society of Professional Engineers.

In summing up his appeal to Senator Long, who is chairman of the Subcommittee of the Senate Armed Services Committee, Mr. Brown, in his letter, referred to a statement made by General Omar N. Bradley at West Point on April 15, in which General Bradley said, "In many instances we are going to have to compromise our needs to allow the first-rate men to stay with science and with industry. We may have to override the personal desires of the man himself. As harsh as it may seem, many men who would urgently desire to put on a uniform and participate may have to remain at other posts as civilians in the laboratories and in industry to provide the sinews that this nation's war machines must have."

Government Purchasing Practices Commended

Federal Standards Policy Praised

THE purchasing and procurement practices of the armed services were praised recently by T. D. Jolly, Fellow ASME, vice-president of the Aluminum Company of America, at a Company-Member Conference of the American Standards Association held in Norfolk, Va.

Because of flight conditions, Mr. Jolly was unable to reach Norfolk and deliver his address personally. It was read for him by Vice-Admiral G. F. Hussey, Jr., USN (Ret), managing director of the American Standards Association, New York, N. Y. In his paper Mr. Jolly declared that the Government's newly announced policy of using the standards of private industry in its buying, instead of writing its own federal specifications, can save American industry and the American people millions of dollars and countless hours of wasted motion. He called it possibly the most important forward step the government has ever taken in standards work.

Mr. Jolly quoted a new federal directive produced jointly by the Munitions Board and the Federal Standards Branch as reading: "Nationally recognized industry and technical society standards and specifications shall be used to the maximum extent practicable in the development of Federal and military specifications and standards." This means that the government will no longer write its own specifications for such articles of common use as chairs, pencils, and photographic equipment, but will now accept the standards of qualified manufacturers.

Mr. Jolly hailed this as an almost complete reversal in attitude by the federal agencies. He has frequently criticized government officials for distrust and suspicion of private industry in standards matters, and for not making fuller and better use of the manufacturing standards made available by industry.

New Standards Directive

Rear Admiral Joseph W. Fowler, USN (Ret) Director of Supply Management Agencies in the Munitions Board, also addressed the conference on the new standards directive. He mentioned as unfortunate the Munitions Board policy that sharply restricts the Board's dealings with industry and technical societies, but said that everything possible is being done to bring about closer liaison.

"Wherever possible," he said, "we are adopting industry standards, believing that the interests of the government will be best served by adherence to the practices and procedures of normal industry operation. We have been fighting a battle against overspecification, rigid specifications which limit the production base, and standards which sponsor bottlenecks."

Military Procurement Problems

Mr. Jolly expressed the belief that the American public does not realize how big and complicated the problem of military procurement is, or how much good work has been accomplished toward remedying bad purchasing practices. Specifically, he praised the progress made in a Federal Catalog System, which he said will identify its 2,500,000th item sometime this month. The catalog of articles of military use will be completed in 1953 or shortly thereafter, and the civilian catalog in 1954 or 1955.

In declaring that the layman has a tendency to oversimplify the problems of military procurement in terms of his own experience, Mr. Jolly attacked the widely accepted concept of centralized buying for all the military services. He stated that the method was inflexible, and that after a certain point, bulk buying no longer produced a price advantage, since no manufacturer wants his entire output absorbed by the government.

Standardization of purchases, not centralization, he said, is the answer to the government's procurement problems. An adequate Federal Supply Catalog, he added, will help make such standardization possible.

After dwelling at length on the evils that result when federal officials do not use the available standards of private industry in their purchases Mr. Jolly said there were instances in which lack of uniformity in industry standards has caused serious dislocation in federal procurement. He cited the fact that the Navy

has found 1181 duplicate stock numbers on a single ball bearing it buys from different manufacturers. By eliminating the duplications on identical bearings, it has reduced its replacement stock on this one bearing from 300,000 to 16,500.

"Common sense and all past experience," Mr. Jolly said, "demand that private industry build up a comprehensive, integrated set of national standards for use by military procurement agencies."

60 University Scientists Are to Spend Summer in Oak Ridge Research

THE annual summer migration of Southern university faculty members to Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn., began early in June. Sixty university faculty members reported there for three months of research.

The group this summer will bring to 245 the number of appointments of university faculty members for research at Oak Ridge.

The great majority of the visitors are there during the summer months, although a smaller number take leaves of absence during the regular school year for this purpose. Twenty-two such leaves were granted during the past school year.

The Oak Ridge research participation program is carried out jointly by the Oak Ridge Institute of Nuclear Studies and the Oak Ridge National Laboratory. The Institute is a nonprofit educational corporation composed of 29 southern universities. Oak Ridge National Laboratory is the nation's largest atomic-energy research center. It is operated for the Atomic Energy Commission by the Carbide and Carbon Chemicals Company of the Union Carbide and Carbon Corporation.

Of this group, 54 will be at Oak Ridge National Laboratory, 4 will be with the Institute, and 2 will be with the UTAEC Agricultural Research Program. Details of the Research Participation Program were worked out by Dr. M. T. Clark, acting chairman of the University Relations Division of the Institute, and Dr. F. C. Vonder-Lage, director of the Educational Relations and Training Division of Oak Ridge National Laboratory.

National Power Show to Be Held in New York Dec. 1–6, 1952

ANNOUNCEMENT is made that the Twentieth National Exposition of Power and Mechanical-Engineering Show will be held in Grand Central Palace, New York, N. Y., Dec. 1–6, 1952. It will be held again under the auspices of The American Society of Mechanical Engineers, whose Annual Meeting will be in session, Nov. 30–Dec. 5, 1952, at the Statler Hotel, thus assuring a large attendance of professional men.

As heretofore, the biennial event will include exhibits representing every kind of equipment used in the generation and distribution of power, with specific applications in many new and more efficient ways. There will be upward of 300 different kinds of products on display, occupying three entire floors of the Palace.

Inquiries from prospective exhibitors already have indicated sharply accentuated interest in this year's show. Advance reservations have actually been filed in sufficient volume to insure booking to capacity long before the opening date.

The National Power Show was founded in 1922, and consequently is celebrating its thirtieth anniversary this year. Seventeen of the 19 previous displays were held in Grand Central Palace, but during the intervening two world wars that structure was occupied by the military, forcing the temporary migration of the show to Madison Square Garden.

Management of the Power Show continues under the International Exposition Company, with permanent headquarters in the Palace. C. F. Roth is manager of the exposition. E. K. Stevens is associate manager.

Computing Machines Subject of Interesting Meeting

THE Mellon Institute played host to more than 500 members and guests of the Association for Computing Machinery, May 2–3, 1952. The meeting was international in scope, including visitors from Canada and England.

Three papers of general interest marked the opening session at Soldiers and Sailors Memorial Hall. R. V. D. Campbell, of the Burrough's Adding Machine Company, spoke on the "Evolution of Automatic Computing." W. Shockley of the Bell Telephone Laboratories, in an address entitled "Transistor Physics," gave a vivid account of the principles of operation of the newest of solid-state electronic devices, the transistor amplifier. Howard Aiken, of the Harvard Computation Laboratory, and inventor of the first automatic sequenced calculator, the Mark I, reported on his best and newest computer, the Mark IV.

The general session was followed by three groups of three parallel sessions at the Mellon Institute. In all, 48 papers were presented covering every phase of the technique of automatic computing. Several general-purpose automatic digital computers were described, including the new Remington-Rand punch-card electronic calculator and the new IBM scientific calculator. A large number of papers were devoted to specialized digital data processors and to computer components. Two of the latter papers were contributions of the Computer Components Fellowship of Mellon Institute. The first on "Nonlinear Switching Elements," was the work of F. A. Schwertz, B. Moffat, and Byron O. Marshall, Jr.; the second was presented by Byron O. Marshall, Jr., J. R. Bowman, and F. A. Schwertz.

On the theoretical side, two historical "firsts" were represented by sessions on the "Use and Construction of Subroutines" in effecting numerical calculations, and the use of "Formal Logic in Circuit Synthesis."

An especially interesting activity of the meeting was an exhibit which featured some old mechanically operated desk calculating machines dating as far back as 1870. These were described at a banquet of the Association at which G. C. Chase, of the Monroe Calculating Machine Company, spoke on the "History of Mechanical Computing Machinery."

The Mellon Institute proved an ideal site for the meeting, and the Local Arrangements Committee, consisting of J. R. Bowman, chairman, B. O. Marshall, Jr., B. Moffat, F. A. Schwertz, and R. T. Steinback, thanked President Weidlein for making the Institute facilities available to the Association.

The U. S. Patent Office 2,000,000th Patent Expires

THE National Patent Council announced that the 2,000,000th patent issued by the U. S. Patent Office expired recently. This means that the public has benefited from the free use of approximately 2,000,000 inventions since the establishment of our Patent System.

The 2,000,000th patent was issued to Joseph Ledwinka of Philadelphia, Pa., for his invention of a "Vehicle Wheel Construction." The patent was assigned to the Edward G. Budd Manufacturing Company of Philadelphia. The invention was an adaptation of a pneumatic tire for rail travel.

For the past 17 years, the life of each U. S. patent, the Budd Manufacturing Company has had the inducement to put its capital behind Mr. Ledwinka's invention and expand its market in the railway-equipment field, National Patent Council explained. In this process many new jobs were created, in providing a new service to the public. Today anyone may manufacture, use, or sell the Ledwinka invention without the payment of any royalty or license fee to Mr. Ledwinka or the Budd Manufacturing Company. This also applies to the 1,999,999 other inventions, the patents for which have expired.

J. W. Anderson, president of National Patent Council, said, "All other nations in the world combined cannot boast of anything approaching a similar record of inventions over an equivalent span of years. These two million inventions are largely responsible for America's industrial growth and for its position as the outstanding leader in the industrial economy of the world today. The incentives held out by our Patent System have inspired the inventions that have helped make America strong."

ASME Membership as of May 31, 1952

Honorary Members	52
Fellows	371
Members	13,187
Associates	353
Juniors (33 and over)	3,264
Juniors (30–32)	1,880
Juniors (To the age of 29)	16,689
Total	35,796

Demand for Engineers Greater Than Ever

DOZENS of job opportunities with starting salaries that average $332 a month were pressed upon engineering students at Illinois Institute of Technology who were graduated in June, according to E. C. Kubicek, the Institute's placement director.

"Competition for the graduating engineer is at its very highest in history," Mr. Kubicek related. "Everyone wants to hire an engineer. In the past three months more than 250 corporations, represented by from one to six interviewers, have visted the school, anxious to meet the graduating engineers and present the advantages of employment by their companies."

Registration records for the IIT placement office reveal that recruiters from an average of six companies visit the campus every day. Thousands of other job opportunities are described in letters and bulletins also received.

"Within the past few months, government agencies, civil service as well as military branches, have entered into the competition for graduating engineers," Mr. Kubicek said. "Various civil-service agencies from all over the nation are sending teams of representatives to recruit personnel in colleges. Military branches are offering the graduate engineer an immediate rank as a line officer.

"The current shortage of engineers would be alarming even under normal conditions, due to the low birth rate of the 1930's now being felt in the colleges and high schools. Selective-service demands will heighten the shortage even more. The low point in engineers, as well as in other fields, will not be hit until 1953.

"There is a marked tendency in industry toward utilization of engineers in sales and contract negotiation work," according to Mr. Kubicek. "Many companies have adopted the view that it is easier and more successful to train engineers in sales than salesmen in technical fields."

What Happened to Rosie-the-Riveter's "Lady" Boss?

WHAT has happened to the girls who became engineers and industrial specialists under the pressures of the war emergency? Would they advise girls of today to become engineers and help meet the drastic shortage of technologists in the defense mobilization?

These are two of the questions Rensselaer Polytechnic Institute recently asked the 84 young women who in December, 1943, completed an intensive 10-month course at Rensselaer as engineer aides in the aircraft-propeller industry. These 84 were one group of the 800 girls whom the Curtiss-Wright Corporation chose from 350 colleges throughout the country and sent to eight engineering colleges early in 1943 to train for special work in the aircraft industry.

Only 34 of the 84 answered the questionnaire. All except one of the 34 were positive in recommending a similar course of study and work to the young college woman of 1952. They further recommended the course for the following reasons: They enjoyed the training and felt it fitted them to do a job successfully, the engineering experience proved valuable, engineering offered women higher salaries than were paid in home economics or the other professions in which women are generally engaged, and through the course they had gained a perspective which proved invaluable in solving problems.

Twenty-four of the 34 engineer aides are married, nine have one child, seven have two, and six have three children, but only 14 in all have definitely given up the idea of taking a future job.

The girls reported work experience ranging from nine months up to 100 months in duration, at jobs such as draftsmen, engineering aides, teaching, and engineering secretaries.

Only two of them felt they were not suited for engineering although three held that salaries had not proved commensurate with the amount of training and that women have no real chance to compete with men engineers on an even basis. Another said there were not enough jobs with a real opportunity for a highly trained women.

Such views found a strong answer in the response of a Philadelphia girl who declared engineering as rewarding and satisfying for a woman as for a man. Many women are more suited to this type of work than the more usual women's professions because women often prefer to work alone, have patience, and the common sense which a good engineer must have.

A frequent comment among the girls who trained as engineer aides, however, is that girls should go out for engineering degrees and win the security that comes in industry with the higher brackets of professional employees.

Engineers Urged to Take Part in Public Affairs

G. B. Warren Honored by University of Wisconsin

Greater participation by professional engineers in public affairs is urgently needed during these critical times, Glenn B. Warren, Fellow ASME, general manager of the General Electric Company's Turbine Division, said at a dinner meeting climaxing the University of Wisconsin's fourth annual Engineers' Day. Mr. Warren, whose headquarters are in Schenectady, N. Y., said the engineer "has both a right and an obligation to participate" in public life.

The G-E executive received a distinguished service citation from the university, along with seven other prominent engineers and industrialists.

Pointing out that science and engineering have progressed rapidly since the introduction of the experimental method a few centuries ago, Mr. Warren said: "Unfortunately, this method cannot be applied so readily to the economic, industrial, political, social, and other human-relations problems."

Mr. Warren attributed the relatively small participation of technically trained men in public affairs to the shortage of engineers, the tremendous increase in their workload and responsibilities, and the fact that they must continually study to keep abreast of technological advances.

He emphasized that public affairs requirements that can be satisfied by the engineering viewpoint cannot be met by just "part-time participation" of engineering and administratively trained men.

To satisfy these needs fully, he urged: that engineers as citizens should insist that government participation in business be strictly limited to those functions which government can and should be able to perform better than private groups; that adequate steps be taken to educate more properly qualified young people for the engineering profession; that engineers as citizens should insist that government salaries for professional talent be comparable to those in private business; that the jobs carry equal dignity and security so as to attract and hold capable men; that experienced engineers and administrators retired at 65 by private industry be encouraged to go into public or government service for periods of from three to five years; that professional public-affairs administrators be trained and developed to a greater extent than is now being accomplished.

"The value of the engineer in public life," he said, "is measured by his knowledge of industrial engineering and power economics, his understanding of structures in the broad sense, and his 'honesty of approach developed because he has learned that nature can't be cheated . . . can't be made to produce something for nothing.'"

"A good engineer," he said, "gets all the facts he can before deciding on a course of action, examines possible alternative courses and the results that would accrue, and tries to select the optimum." Qualifications for men in public service should be the same, he pointed out.

"I believe," he declared, "we need the practical, informed, and so intellectually honest approach to public affairs that the engineer has brought to our private industrial affairs. This cannot, in my judgment, be obtained by the part-time attention of engineers on a layman basis in government, but must be obtained by professionally trained public administrators who will need much, but not all, of the technical training of the engineer, supplemented by the broader training required of this field."

Cited, in addition to Mr. Warren, were *W. A. Olen*, president, Four-Wheel Drive Auto Company, Clintonville, Wis.; *R. C. Johnson*, president, Siesel Construction Company, Milwaukee; *G. P. Steinmetz*, chief engineer, Wisconsin Public Service Commission, Madison; *B. S. Reynolds*, director of the Burgess Company and of the Research Products Corporation,

both of Madison; *J. F. Wolff, Sr.*, engineering consultant, Oliver Iron Mining Division, U. S. Steel, Duluth, Minn.; *W. E. Crawford*, Mem. ASME, director of research and engineering, A. O. Smith Corporation, Milwaukee; and *O. E. Andrus*, assistant director of research and engineering, A. O. Smith Corporation, Milwaukee.

University of Michigan Plans for Centennial

PLANS are under way for a centennial celebration of the inauguration of engineering courses at the University of Michigan.

A convocation on Oct. 23–24, 1953, will mark the opening of the centennial program. G. G. Brown, dean of the college of engineering, has appointed a faculty committee, headed by Prof. S. S. Attwood, aided by a five-member alumni advisory group, to complete arrangements.

When the University was moved from Detroit, Mich., and re-established in Ann Arbor in 1837, engineering was one of the subjects the Regents believed should be offered. It was not until 1853, however, that any action was taken to name a faculty member to teach civil engineering.

At their meeting of Nov. 16, 1853, the Regents decided that Alexander Winchell, then in Alabama, was the faculty member they wanted. Negotiations with him were completed and he arrived on campus early in 1854. A course in civil engineering was inaugurated when the next term began on March 31, 1854. Engineering courses were continued as a part of the literary college until 1895, when a separate college of engineering was established.

The faculty members of the centennial committee, in addition to Professor Attwood, are: E. F. Brater, J. A. Bolt, A. B. Macnee, G. B. Williams, W. C. Nelson, W. W. Hagerty, Jun. ASME, C. W. Spooner, Jr., Mem. ASME, W. W. Gilbert, Mem. ASME, and W. E. Britton. Each represents one of the ten departments in the college of engineering.

The alumni advisory committee includes Wyeth Allen, Mem. ASME, president of Globe-Union Inc., Milwaukee, Wis.; L. R. Crandall, president of the George A. Fuller Company, New York, N. Y.; J. F. Fairman, vice-president of Consolidated Edison Company of New York, Inc., who is administrator of the Defense Electric Power Administration of the Department of Interior; G. W. Mason, president of Nash-Kelvinator Company, Detroit; and H. M. Merker, consultant for Parke, Davis & Company, Detroit.

Soldier-Statisticians Form Professional Society

A PROFESSIONAL society of college-trained soldier-scientists in the fields of statistics and quality control has recently been organized at Army Chemical Center, Md., which is the research and development headquarters of the Chemical Corps, U. S. Army.

A nucleus of twenty enlisted men, assigned to the Chemical Center in various jobs within these fields, have banded together to form the society. (These military specialists are classified under the Army's Scientific and Professional Personnel Program, designed to utilize the civilian background and educational experience of technically trained enlisted personnel.)

The Army Chemical Center Industrial Statistics Society is the name the men have given to their organization, and the statement of their aims and purposes reads as follows: "The ACC Industrial Statistics Society brings together the statisticians, biometricians, and quality-control engineers of the Technical Detachments at the Army Chemical Center: To facilitate a beneficial exchange of technical, theoretical, and methodological information among its members; to serve the Chemical Corps and the Armed Forces by encouraging and inculcating the use of modern and effective methods of statistical analysis, quality control, and design of experiments; to associate with national societies of statisticians and quality-control engineers and coordinate with their activities; to bring experts in these fields to the Chemical Center to improve the existing state of knowledge; to correspond with technical and scientific publications concerning noteworthy developments and discoveries of its members; to present to its members scientific papers of interest; to foster mutual good will and understanding between statisticians, biometricians, and quality-control engineers in the Armed Forces and in industry."

Du Pont Wins Safety Award

FOR the tenth consecutive year E. I. du Pont de Nemours and Company, Inc., has the National Safety Council's highest industrial award, its Award of Honor for 1951.

The company set a new low record of accident frequency last year, the safest in du Pont history. The frequency rate—that is, the number of time-losing injuries per million manhours worked—was 0.67 for the company's combined operations last year. This was an improvement of about seven per cent over 1950, du Pont's previous best year. The rate is substantially less than the most recent available rate of 5.82 for the chemical industry as a whole and the 9.30 for all industry, which have themselves been much improved in recent years.

Is There Strength in Unity?

AT a joint meeting of the Long Island Division of The American Society of Mechanical Engineers and the Nassau County Chapter of the New York State Society of Professional Engineers, to discuss the Unity Plan, W. H. Larkin, Mem. ASME, reviewed previous attempts at organizing engineers into a common association and pointed out several principles which have evolved during the past 30 years.

"We have today over 90 national bodies representing almost as many different fields of engineering," Mr. Larkin said. "In bringing these groups together, it is wise first to seek grounds for agreement, and to avoid emphasizing points of disagreement. Much more can be achieved through persuasion than through coercion."

In discussing existing unity, Mr. Larkin cited two outstanding examples of organizations supported by several societies—the Engineers' Council for Professional Development (ECPD) and the Engineers Joint Council (EJC). ECPD is primarily concerned with engineering education, student guidance, ethics, and so on, while EJC co-operates with government authorities to formulate national and international policies in fields where the engineering profession has competence. Both organizations are doing necessary jobs in areas in which they are qualified. They have built up a tradition and heritage which we cannot afford to lose; the status of these two groups must be continued and protected in any new unity organization.

Our technical societies have served the profession so well for such a long time, and they have earned such prestige in the eyes of the public, that they are the ones to whom engineers will ordinarily turn to represent their technical interests. The technical societies are competent in their respective fields, are doing a fine job, and certainly must be expected to carry on.

The National Society of Professional Engineers (NSPE), the state PE societies, and their county chapters all over the country are contributing a necessary service in resisting labor and other pressure groups at all levels, national, state, and county. They consider that legislation, registration, ethics, law enforcement all fall within their jurisdiction. These groups have done considerable ground work in fields which the technical societies have never touched, and they must continue this work.

There is little doubt that the technical societies will dominate the unity organization because of their overwhelming strength. However, Mr. Larkin suggested, they can well demonstrate their good faith toward NSPE by adopting a platform along the following lines: (1) The constitution of the unity organization shall define explicitly the interests, fields of activity, and duties of the component groups; (2) no constitutional provisions may be changed without the consent of the groups specifically affected; (3) part of the dues should be earmarked for EJC, ECPD, and if the member is registered, for NSPE.

In summing up, Mr. Larkin said a unity organization must have obvious and tangible advantages so that it can be sold to all engineers and enjoy their solid support. The multiple duties of a unity organization will cost money, and engineers must be willing to foot the bill. A unity organization will secure the rights and integrity of the engineer as a professional and intellectual worker, and he must lend his financial support to both the technical and the professional divisions.

Mr. Larkin, who is a member of the New York State Board of Professional Engineers, is also the chairman of the Admissions Com-

mittee, ASME, and past-president, of NYS-SPE. George Nicastro, who is vice-president of NSPE and past-chairman of ASME Metropolitan Section, presided at this meeting.

SAM-ASME Time-Study Conference Reaches Large Audience

THE application of time study and methods to all areas of operative management was the theme of the seventh annual Time-Study and Methods Conference sponsored by the Society for Advancement of Management, Inc., and the Management Division of The American Society of Mechanical Engineers, held at the Statler Hotel, New York, N. Y., April 24–25, 1952.

Approximately 1800 attended the five sessions during the two-day program, with 16 outstanding management men covering all levels and areas of management. The first part was built upon the application of methods and techniques and the second part reports the latest important research in the field of time study and methods study.

One of the features of the conference were the SAM time-study rating films. D. B. Porter, Mem. ASME, professor of industrial engineering, New York University, New York, N. Y., presented "Recent Research on SAM Rating Films." Professor Porter told what the recent research covers and the subjects which will be delved into in future research. The films were shown in full after each of the sessions.

The modern concept of materials handling is that all materials handling is transportation and all transportation is materials handling, said C. C. Crowley, Jr., manager, materials-handling department, The Singer Manufacturing Company, Elizabeth, N. J.

Therefore, all handling operations involved in manufacturing, i.e., receiving, storing, processing, packing, shipping, and so on, lie within the realm of the materials-handling engineer. How deeply concerned the engineer becomes is usually a matter of individual plant organization. In each of the functions performed in the manufacturing procedure, the problem of job content and wage payment are always present. The role of the time-study, methods, and materials-handling departments and the co-operative procedures required by these departments in effecting efficient operation were discussed and evaluated.

D. F. Copell, vice-president, Engineering and Personnel Training, Wagner Baking Corporation, Newark, N. J., covered the application of time study and methods to tools, equipment, and layout. Mr. Copell presented a film showing actual applications and charts illustrating the results of these applications. He pointed out how a work-simplification training program and an engineering department can work with the production department to conceive, develop, and install better tools, better equipment, and better layouts.

The Thursday luncheon speaker was W. H. Wheeler, Jr., president of Pitney-Bowes, Inc., of Stamford, Conn., who spoke on how time-study and methods techniques help members of top management fulfill their responsibilities to their customers.

We have always believed that we owe our customer the fullest measure of value that we can provide, Mr. Wheeler said. That is our chief responsibility to him—the best possible product for the least possible money. Every department in the company works toward the achievement of that goal, some in a more apparent fashion than others. For example, our engineers design the best machine they can and our service department gives the best service they know how to give. With time-study techniques and methods work our industrial engineers are helping us to meet one of our primary responsibilities—that of giving the customer his money's worth.

The Friday luncheon speaker, Henderson Supplee, Jr., executive vice-president, the Atlantic Refining Company, Philadelphia, Pa., had as his subject how time-study and methods techniques help members of top management fulfill their responsibilities to their stockholders. Time-study and methods-analysis techniques are too frequently thought of as primarily applicable in the development of wage-incentive planning. While not intending to minimize the value of sound wage-incentive plans designed through the use of these techniques, an attempt will be made to set the sights of industrial engineers toward a much broader application.

Time and methods analysis, unless integrated in the early stages with the ultimate objectives of over-all management, will fall pitifully short of its true potential value. Mr. Supplee directed his talk toward efforts being made in the Atlantic Refining Company to integrate these techniques with broad programs such as operation analysis, organization planning, policy formulation, and short and long-range planning of operation and capital investments, budgeting, and other programs aimed at cost reduction or improved performance—all this toward the end of discharging managements' responsibilities to the stockholder.

The dinner-session speaker was R. L. Putnam, president and chairman of the board, the Package Machinery Co. of Springfield, Mass. Mr. Putnam has recently been appointed Economic Stabilization Administrator by by President Truman. He reviewed the past, explained the present, and projected the future of price stabilization. His thinking and recommendations will have a direct effect on much economic activity during the years of defense preparation.

ASTE TOOL-ENGINEERING RESEARCH FUND DISCUSSED

(Research directors of several universities and leading research laboratories met recently in Detroit, Mich., with officials of the American Society of Tool Engineers to discuss activities and plans for the society's newly established Tool-Engineering Research Fund. It was generally agreed that the initiation of tool-engineering research programs should be pushed as rapidly as possible in the interest of maintaining Western industrial leadership. Seated, *left to right:* H. F. Poehle, University of Michigan; Prof. O. W. Boston, Fellow ASME, University of Michigan; L. B. Bellamy, ASTE president; Prof. J. N. Edmondson, Ohio State University; W. H. Browne, Mem. ASME, Battelle Memorial Institute; Dr. J. S. Owens, Champion Spark Plug Company; and Dr. Paul Pepper, Ohio State University. Standing, *left to right:* H. E. Conrad, ASTE executive secretary; A. F. Denham, ASTE public relations counsel; Dr. W. E. Mahin, Armour Research Foundation; F. W. Wilson, ASTE technical director, and M. J. Bunting, ASTE staff.)

People

SIMON COLLIER, director of quality control, Johns-Manville Corporation, New York, N. Y., was elected as president of the American Society for Quality Control at the sixth annual convention, which was held at the War Memorial Auditorium, Syracuse, N. Y., May 22–24, 1952.

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A. A. POTTER, Hon. Mem. ASME, dean of engineering, Purdue University, Lafayette, Ind., was among the eight members of the 24-member National Science Board of the National Science Foundation whose initial two-year terms expired, to be reappointed by President Truman for a six-year term, ending May 10, 1958.

F. H. NERLY, Fellow ASME, chairman of the board, Rich's, Inc., Atlanta, Ga., has been named the recipient of the 1952 Gantt Medal. Formal presentation of the medal will be made at the Fall Personnel Conference of the American Management Association to be held in New York, N. Y., Sept. 30, 1952.

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A. C. MONTEITH, Mem. ASME, vice-president in charge of engineering and research, Westinghouse Electric Corporation, was initiated into the Virginia Beta Chapter of the Tau Beta Pi Association at Virginia Polytechnic Institute, Blacksburg, Va., May 16, 1952. At a banquet following the initiation ceremony Mr. Monteith gave a talk on Engineering Progress and Problems in which he stressed the need for continuing research on the part of industry to keep abreast of the ever-increasing demand for electric power.

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A. R. DIAMOND, mechanical engineer, Jackson-Walter Company, Philadelphia, Pa., and R. C. W. PETERSON, owner and chief engineer, Peterson Engineering Company, Toledo, Ohio, members of ASME, were appointed national Education and Standards Committee chairmen, respectively, for the American Society of Tool Engineers, by L. B. Bellamy, president ASTE. Ten other chairmen were also named.

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W. E. CRAMER, president of the Industrial Ceramic Products, Inc., of Columbus, Ohio, became the 54th president of The American Ceramic Society when he took office at the 54th annual meeting held in Pittsburgh, Pa., April 27–May 1, 1952.

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KARL B. MCEACHRON, General Electric Engineer and internationally-recognized authority on lightning, received the 1952 award of the Engineering Societies of New England on May 7, 1952. The award, an inscribed scroll, was presented to Dr. McEachron at the ESNE annual meeting and dinner in the Puritan Hotel at Boston, Mass.

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A. V. ASTIN, Government scientist and weapons expert, was nominated by President Truman as director of the National Bureau of Standards. Dr. Astin has been acting chief of the bureau since last October, shortly after the resignation of E. U. Condon.

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W. D. COOLIDGE, director emeritus of the General Electric Research Laboratory, Schenectady, N. Y., and x-ray consultant to the company, was the first recipient of the K. C. Li Medal "for meritorious achievement in advancing the science of tungsten." Presentation of the medal was made to Dr. Coolidge, May 20, 1952, in the Men's Faculty Club of Columbia University, New York, N. Y. Dr. Coolidge received the gold medal, which carries with it a prize of $1000, "for his conception and development of a method for obtaining ductile metallic tungsten to the benefit of all mankind."

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H. S. GIBSON, managing director, Iraq Petroleum Company, Ltd., and associated companies, was elected president of The Institute of Petroleum for the 1952–1953 Session, at the annual general meeting of the Institute held on April 24, 1952.

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JOSEPH MARIN, Mem. ASME, professor of engineering mechanics and research professor of engineering materials, was recently awarded a Fulbright Professorship to lecture at the Technological Institute at Trondheim, Norway for the academic year 1952–1953.

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M. E. MERCHANT, Mem. ASME, senior research physicist, Cincinnati Milling Machine Company, Cincinnati, Ohio, was elected president at the annual meeting of the American Society of Lubrication Engineers. Another among the newly elected officers is W. P. YOUNGCLAUS, JR., Jun. ASME, field representative, industrial lubricants, Alemite Division, Stewart-Warner Corporation, Chicago, Ill.

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RALPH L. WILSON, Mem. ASME, director of metallurgy, Timken Steel and Tubes Division, Timken Roller Bearing Company, Canton, Ohio, was nominated for president of the American Society for Metals during the 1952–1953 term.

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I. D. WOOD, irrigation engineer, Soil Conservation Service, U. S. Department of Agriculture, Denver, Colo., was awarded the John Deere Gold Medal, and C. H. SCRANTON, chief engineer, Allis-Chalmers Manufacturing Company, La Porte, Ind., received the Cyrus Hall McCormick Gold Medal, in honor of their outstanding engineering achievement in the field of agriculture, at the American Society of Agricultural Engineers' annual dinner held at the Hotel Muehlebach, Kansas City, Mo., June 18, 1952.

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E. S. PETTYJOHN, director, Institute of Gas Technology, affiliated with the Illinois Institute of Technology, Chicago, Ill., has been appointed as vice-president, the first in the history of IGT, in recognition of his contribution as director to the Institute's rise to its present eminent position in the fields of research and education. At the same time J. D. PARENT was named as dean, and HENRY R. LINDEN and C. G. VON FREDERSDORFF as assistant research directors.

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PALMER W. GRIFFITH, West Coast technical sales director of American Cyanamid Company, received the eleventh annual John Wesley Hyatt Award "for achievement of wide importance to the plastics industry" at the award banquet held at the Hotel Pierre, New York, N. Y.

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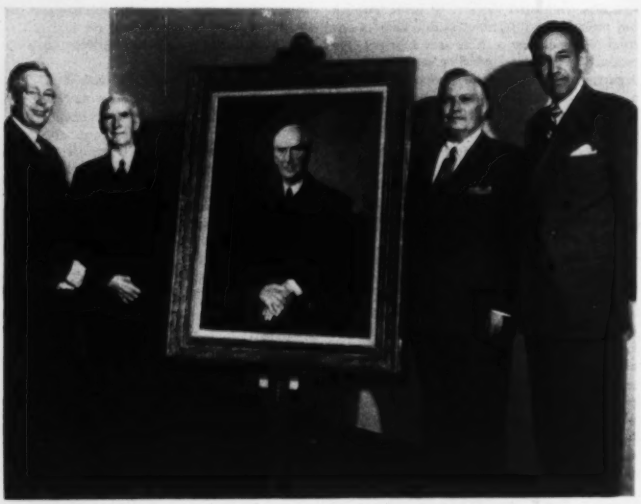
GORDON BROWN, vice-president, The Bake-



THE PORTRAIT OF DR. DEXTER S. KIMBALL, RETIRED DEAN OF THE COLLEGE OF ENGINEERING AT CORNELL UNIVERSITY, ITHACA, N. Y., WAS PRESENTED AT A RECEPTION HELD IN WILLARD STRAIGHT HALL

(*Left to right:* Prof. S. C. Hollister, Mem. ASME, present dean of the college; Dean Kimball, Hon. Mem. ASME; Walker L. Cisler, Fellow ASME, Cornell engineering alumnus and trustee, the donor; and Deane W. Malott, president of the University. Painted by Thomas E. Stephens of New York, N. Y., the portrait will be placed in Kimball Hall, a materials-processing laboratory under construction on the campus.)

lite Company, division of Union Carbide & Carbon Corporation, was re-elected president of The Society of the Plastics Industry, Inc., for a second year effective Jun: 1, 1952.

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CHARLES F. KETTERING, Fellow ASME, research consultant to the General Motors Corporation, was presented with a 1952 Horatio Alger plaque by the Horatio Alger Awards Committee Colleges Association for his work in enhancing "the American tradition of overcoming obstacles to achieve success."

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CLIFFORD H. FRICK, Mem. ASME, manager, Coal Bureau for the Pennsylvania Power & Light Company, Allentown, Pa., was elected president of the Lehigh Valley Chapter of the Pennsylvania Society of Professional Engineers.

ASME Elects 16 Fellows

THE American Society of Mechanical Engineers has honored 16 of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow one must be an engineer who has acknowledged engineering attainment, 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and has been a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men whose outstanding contribution to their profession and to the Society were so honored are:

E. Stanley Ault

E. STANLEY AULT is head of the department and professor of machine design at Purdue University, Lafayette, Ind., and a consulting engineer on design and technical publication problems. He has made significant contributions to engineering in the field of education, where his work has had an influence on educational practices and curriculums in mechanical engineering, particularly in the field of machine design. At Purdue he has extended and developed courses and a laboratory in machine design for undergraduate and graduate instruction. He has also developed methods of analysis of engineering problems. Professor Ault is coauthor, with Norman and Zarobsky, of "Fundamentals of Machine Design," a book published by The Macmillan Company in 1938. He wrote the section on roller bearings in Kent's "Mechanical Engineers' Handbook, for 1950, and has contributed various articles to the technical press and engineering journals. Elected Jun. ASME, 1921, Professor Ault has served the Society as secretary and later as chairman of the ASME Cleveland Section and as chairman of the ASME Machine Design Committee.

John Blizard

JOHN BLIZARD, director of research, Foster Wheeler Corporation, New York, N. Y., has assisted importantly in pioneering the application of pulverized-fuel firing to power-plant boilers. He has contributed to the design of boilers, superheaters, and economizers for the ever-increasing capacities, temperatures, and pressures which have taken place during the past 30 years While a lecturer in mechanical engineering at McGill University, Montreal, Que., Can., from 1906 to 1911, he was in charge of boiler and gas-producer tests for the Dominion Government. Later he worked for the Department of Mines, Ottawa, Ont., Can., for nine years, where he was again in charge of these tests.

From 1920 to 1923 he held the position of chief of the fuel section at the Pittsburgh Experiment Station of the Bureau of Mines. While there he directed investigations of the combustion of pulverized coal and other fuels in land and marine boilers and he is the author of bulletins and technical papers describing this work.

In his present position he has contributed to the development of steam generators for power plants, merchant ships, and for Naval vessels. He holds several patents.

Frederick L. Dornbrook

FREDERICK L. DORNBROOK, retired general consultant, power-plant department, Wisconsin Electric Power Company, Milwaukee, Wis., is well known as a pioneer in the use of pulverized coal and has made many important contributions to power-plant technology. He has invented and designed equipment for the preparation, handling, and burning of pulverized fuels, high-pressure and temperature power-plant equipment, reheat cycle, topping turbines, and similar equipment. Mr. Dornbrook was awarded the ASME Medal in 1949 and was cited by the University of Wisconsin "for materially aiding in the increasing of power-plant efficiency to its present high level." In his 55 years of service in the field of marine engineering and with the Wisconsin Electric Power Company, he progressed successively from coal passer, fireman, and oiler, to assistant marine engineer, field engineer, superintendent of power-plant equipment, and finally to chief engineer of power plants, a position he held for 27 years. Mr. Dornbrook has written various articles on power plants and pulverized-coal firing and holds individually or jointly eight patents.

Harold Arthur Everett

HAROLD A. EVERETT, professor emeritus, The Pennsylvania State College, is a consulting engineer for The Texas Company and The Aviation Corporation, having retired in 1946 as head of the mechanical-engineering department at The Pennsylvania State College. He was graduated from Massachusetts Institute of Technology in 1902, with a BS degree in naval architecture; and received an ME degree from The Pennsylvania State College in 1924. He has made important contributions to engineering in the fields of naval architecture, thermodynamics, and lubrication. During the period from 1934 to 1943 he authored 11 publications which have helped advance the science of engine lubrication. In 1937 he developed methods for testing engine oils for performance under rigorously controlled conditions. A paper telling of these methods was presented by him, by invitation of The Institution of Mechanical Engineers, in London in 1937, under the title "Rating Oils for Cylinder Wear by the Iron-Contamination Method." The same year he had a textbook, "Thermodynamics," published. Since his retirement from teaching and administrative work he has continued his researches under the sponsorship of The Texas Company. His most recent work has been in the field of combustion studies in engine cylinders. In 1948 the ASME published his revised temperature-entropy diagram. For over 15 years he served the Society as a member of the ASME Special Research Committee on Lubrication.

Martin Frisch

MARTIN FRISCH, vice-president in charge of engineering, and director, Foster Wheeler Corporation, New York, N. Y., has contributed significantly to the development of modern practices in fuel pulverizing and steam generation. He has developed many improvements in pulverizers, burners, steam generators, water-cooled furnaces, fuel handling, dust collection, and similar equipment. His invention of a level-control system for ball mills has led to an increased use of ball mills in central stations for hard low-grade fuels. This has resulted in the development of direct-fired pulverized-anthracite systems whose wide-scale adoption made millions of tons of waste-anthracite culms and silt useful and economically valuable. His development of

ASME Calendar of Coming Events

Sept. 8–11
ASME Fall Meeting, Sheraton Hotel, Chicago, Ill.
(Final date for submitting papers was May 1, 1952)

Sept. 8–12
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Cleveland Auditorium, Cleveland, Ohio
(Final date for submitting papers was May 1, 1952)

Sept. 22–24
ASME Petroleum Mechanical-Engineering Conference, Hotel President, Kansas City, Mo.
(Final date for submitting papers was May 1, 1952)

Oct. 30–31
ASME Fuels and AIME Coal Divisions Joint Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.
(Final date for submitting papers was June 1, 1952)

Nov. 30–Dec. 5
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers was July 1, 1952)

April 28–30, 1953
ASME Spring Meeting, Deshler-Wallick Hotel, Columbus, Ohio
(Final date for submitting papers—Dec. 1, 1952)

June 28–July 2, 1953
ASME Semi-Annual Meeting, Hotel Statler, Los Angeles, Calif.
(Final date for submitting papers—Feb. 1, 1953)
(For Meetings of Other Societies see page 614)

twin-furnace and multifurnace steam generators for superheat and reheat temperature control over wide load ranges, has freed high-pressure, high-temperature designs of limitations imposed by slagging characteristics of fuels. This has made possible attainment of high superheat and reheat temperatures with furnace temperatures as low as desired. Another development resulted in "dual circulation" designs in high-pressure boilers which suppressed carry-over and silica in steam to small fractions of the amounts characteristic of conventional steam generators. Mr. Frisch holds 52 patents and is the author of 17 publications. He is a member of the ASME Boiler Code and Nuclear Energy Application committees and a member of the Welding Research Council.

Walter Greacen, 3rd

WALTER GREACEN, 3RD, chief mechanical engineer, New York State Electric and Gas Corporation, Binghamton, N. Y., has been performing outstanding work in power engineering for more than 29 years. He has made many contributions toward the instrumentation, design, construction, and operation of power plants. His experience has covered a wide range of pressures and temperatures from smaller units at about 400 psi and a few degrees super heat to 700,000 lb per hr reheat boilers using 1600-psi boiler pressure, and 1000/1000 F temperatures. Before joining the New York State Electric and Gas Corporation in 1944, he was a sponsor engineer for Gilbert Associates, Incorporated, and had been responsibly connected with the design and erection of new plants or extensions for such companies as the Tide Water Power Company, Wilmington, N. C., the Long Island Water Company, Valley Stream, L. I., the South Carolina Electric and Gas Company, the Pennsylvania Electric Company, and others. He has worked on seven units for the New York State Electric and Gas system which will increase the generating capacity of the system by more than 400,000 kw when completely installed. He has written several technical articles. From 1942 to 1944 he served the Society as manager of the Reading Division of the ASME Lehigh Valley Anthracite Section.

Henry F. J. Hebley

HENRY F. J. HEBLEY, research consultant, Pittsburgh Consolidation Coal Company, Pittsburgh, Pa., has made outstanding engineering contributions in the field of atmospheric and stream pollution. His early conception of the real factors affecting atmospheric pollution helped to bring about the recent modern scientific interest and approach to the solution of the problem. Mr. Hebley hinted at a possible "Donora Tragedy" months before the event took place. At present he is working to bring about a scientific approach toward the treatment of water-borne industrial trade wastes. Besides this work, Mr. Hebley has had a wide range of experience in over 37 years of professional life including the designing and installation of all types of equipment required in modern coal and salt mines; design and erection of modern coal-cleaning and preparation plants, and power and heating systems for railroad roundhouses and stations. While with his present company he was loaned to the U. S. Board of Economic Warfare for service in Australia, and later worked with the World Bank on a similar assignment reporting on the condition of Polish Coal Mines. Mr. Hebley is the author of over 25 articles and the inventor of a coal-cleaning conveyer and dust-extraction apparatus.

Leon Thomas Mart

LEON T. MART is president and general manager of The Marley Company, Inc., Kansas City, Mo., a company he founded in 1922. His outstanding engineering service has been in the creation and improvement of industrial water-cooling equipment. This equipment has been essential to the economic progress of such applications as steam-power plants, petroleum, atomic energy, and many others. Mr. Mart has been the motivating force for the design, research, sales, and construction of Marley spray nozzles, cooling towers, and other water-cooling equipment. He has been responsible for his company's phenomenal growth from a spray-nozzle manufacturing concern in 1922, to the world's recognized leader of the water-cooling-tower industry in 1952, with 650 employees and plants in California, Kentucky, and Kansas. Mr. Mart has made numerous talks on his specialty to ASME Sections and other engineering groups all over the country. He holds 25 patents. His publications include the chapter on "Industrial Water-Cooling Systems," in the "Plant Engineering Handbook," published recently by McGraw-Hill Book Company, and two books, "Summer Weather Data" and "The Engineering Data Manual for Water-Cooling Problems."

Frank Henry Neely

FRANK H. NEELY, chairman of the board, Rich's Inc.; chairman, board of directors, Sixth District Federal Reserve Bank, Atlanta, Ga., has had a distinguished career in industrial engineering, scientific management, and public welfare. His application of scientific management principles to merchandising at Rich's department store has helped build it into a $50 million business, the largest of its kind in the South. Scientific management principles developed at Rich's are now standard practice in many of the nation's department stores. Mr. Neely was the first engineer to apply industrial engineering and scientific management to the manufacture and wrapping of candy, and has made many successful engineering and management changes in textile mills and manufacturing companies. He has done outstanding work in finance, education, government, city planning, community development, and public welfare, for which he has received various honors. In 1926 he was cited as Atlanta's "Best Citizen" for his work in bringing about millions of dollars of civic improvements. During the depression he helped organize and headed a special relief committee in Atlanta. During World War II he organized the War Production Board for eight Southern states. Since then he has been instrumental in the development of Atlanta's community-school program, the school-radio station, and many grants by the Rich Foundation to improve Southern education, including the establishment of the Rich Laboratories of Industrial Engineering at Georgia Institute of Technology. He was the 1951 ASME Roy V. Wright Lecturer. He was recently named recipient of the 1952 Gantt Medal.

Earl C. Payne

EARL C. PAYNE, consulting engineer, Pittsburgh Consolidation Coal Company, Pittsburgh, Pa., is recognized in the coal and coal-consuming industries as a leader among fuel engineers. He is an organizer of programs on research and development to advance the art and profession of fuel engineering, both technical and economic phases. Since 1946 he has organized and directed a program resulting in the testing and wider use of double-screened coal by steam railroads with benefits from a substantial reduction of stack losses, established firing methods and lighting-off procedure to reduce locomotive smoke; has advised on the technical problems and procedures in development of a gas-turbine locomotive to burn coal; organized and financed the Great Lakes Air Pollution Abatement program to reduce smoke from bulk-carrying lake vessels, and other projects. He has introduced a program resulting in Eastern steam plants now being able to burn a wider variety of coal more economically. He is presently leading a national movement in the coal and equipment industries to provide engineering advice on the design of small steam plants. Several times Mr. Payne has been invited by the National Coal Associations to present his recommendations for developing coal markets. He has presented over one hundred technical papers before the ASME and other technical societies.

Ellis L. Phillips

ELLIS L. PHILLIPS, president of E. L. Phillips and Company, New York, N. Y., has made many contributions to the utility field, especially in developing methods of reducing the cost of electricity to the consumer. He was graduated from Cornell University in 1895 with a degree of ME-EE. After working for DeLaval Separator Company and Westinghouse, Church, Kerr &. Company, he went into the consulting field in 1905 with Brubaker Company, a consulting engineering firm, which later became E. L. Phillips and Company. In 1909 he and his associates recognized and united several electric plants in the western part of New York State, including Perry and Warsaw, N. Y. These were the nucleus of a large system in that part of New York State and later included Rochester, Hornell, and Elmira. About the same time he and his associates purchased and merged several isolated gas and electric plants on Long Island into one company, which became Long Island Lighting Company. E. L. Phillips and Company had the responsibility of the design and erection of the power stations and transmission lines for all of these companies. The area covered by Long Island Lighting Company today includes Nassau, Suffolk, and part of Queens County. Mr. Phillips carried on his utility operations until 1945, when he resigned as chairman of the board of Long Island Lighting Company, but is still active as the head of E. L. Phillips and Company and other corporations.

Ray S. Quick

RAY S. QUICK, consulting engineer, Eddystone Division, Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa., has made notable contributions to the development of hydraulic engineering. His paper on "Water-Hammer Theory" in 1927 developed a new and precise method for computing water-hammer pressures which is still considered to be one of the best available and is widely used. Mr. Quick helped to originate methods and devices for surge control to insure the safety of pumping systems in the event of power failure. During World War II he was in charge of engineering activities involving hydraulic turbines, hydraulic presses, testing machines, power tools, and marine products for the power industry, U. S. Navy, and Maritime Commission. Since 1946 he has given attention to the hydraulic-power problems of both domestic and foreign projects, including inspection trips to the Philippine Islands to study and report on hydraulic-power prospects for the Philippine Government; to Formosa to study rehabilitation to hydraulic-power facilities for ECA, as a member of the Westinghouse Electric International Mission; and to Brazil to study new facilities for hydraulic power for Rio de Janeiro and São Paulo. He holds several patents and has contributed papers to ASME publications.

I. Melville Stein

I. MELVILLE STEIN, executive vice-president, Leeds and Northrup Company, Philadelphia, Pa., has made outstanding engineering contributions in the fields of measurement and automatic controls. In 1913, while working for the New York Edison Company, he was in charge of rehabilitation of the instruments of the Dayton Power and Light Company following a flood. In 1917 for a short period he was a personal assistant to Thomas A. Edison in the development of apparatus for detecting location of airplanes and submarines. With his present company he has carried on considerable new product-development work and was responsible for the development, design, production, and sales of a new line of electric and electropneumatic combustion-control apparatus. Under his supervision, as director of research, the company's research department was reorganized into six divisions under separate heads and is now engaged in the development and design of precision measuring instruments for research, teaching, testing, and industrial process control. Mr. Stein is still active in the numerous projects of the department. He has written several papers on his specialty and holds 12 patents.

Edward A. Uehling

EDWARD A. UEHLING, who retired nearly 35 years ago, was formerly head of the Uehling Instrument Company which he organized in 1895. He has made outstanding engineering contributions in the field of instrumentation. Mr. Uehling, who is now 103 years old, showed his inventive ability at an early age by such inventions as a double-handled spade, a collapsible sawhorse, and an acre meter. While in his teens, he invented an automatic farm gate. None of these early inventions was patented. He obtained his first patent on an improved land roller in 1869 and now holds more than 20 patents. During 15 years of active service in the blast-furnace field from 1880 to 1895, he saw the air temperature of these furnaces increased from 700 to 1200 F. These high temperatures demanded new indicating and recording instruments and as a result, Mr. Uehling developed and made practical the first pyrometer that indicated and recorded temperatures up to 2500 F. He also invented the continuous CO_2 indicator and recorder for boiler plants. Before 1900 he became well known for the invention of the pig-iron casting machine, which attracted the interest of German and English ironmasters and was installed in all chief blast-furnace plants in Austria and England. The German iron works developed the electric pyrometer. Mr. Uehling became a member of ASME in 1883, three years after the Society was founded, and is no doubt the oldest member of the Society.

Edward T. Vincent

EDWARD T. VINCENT, chairman of the department of mechanical and industrial engineering, professor of mechanical engineering, University of Michigan, Ann Arbor, Mich., has made outstanding engineering contributions in the field of marine and aircraft engines, and has done much experimentation and research on many types of engines. He was responsible for research and analysis leading to the first concept of ignition-lag and detonation phenomena in the Diesel-type oil engine. He was responsible for the experimental work and development of the aircraft Diesel engines employed in the dirigible R 101. He helped to develop lightweight oil engines for the U. S. Navy. At present he is in charge of government contracts regarding research on combustion processes for jet-type engines and is also assisting in the design and development of aircraft engines, oil engines, ramjet, pulsejets, gas turbines, and similar research. He has contributed to the development of a 2500-hp aircraft engine weighing 1450 lb, highly supercharged oil engines for the U. S. Navy, together with gas-turbine analysis and reports on the possibilities of various special devices for the U. S. Air Force. Mr. Vincent is the author of four books: "Supercharging the Internal-Combustion Engine," Gas-Turbine and Jet Engines," both published by McGraw-Hill Book Company; "The Theory and Practice of Oil Engines," "Internal-Combustion Engines," and many papers.

Gerald V. Williamson

GERALD V. WILLIAMSON, superintendent of power production, Union Electric Company of Missouri, St. Louis, Mo., has made outstanding engineering contributions in the field of large steam-power boilers and in air-pollution control. He helped to develop 500,000 kw of pulverized-fuel-fired steam plants for the St. Louis area and is in charge of operation at 1,200,000 kw of steam and power hydro plants. Mr. Williamson developed the "St. Louis Method" for facilitating short-period measurements of atmospheric dust fall on adhesive cellophane panels. He developed methods of designing pulverized-coal-fired boiler furnaces that have led to the design and successful installation in 1950 of two 1,100,000-lb steam per hr boilers at Venice No. 2 station, the first super large boiler west of the Atlantic Seaboard. He assisted in the development of hydrostatic studies which led to placing Meromec Power Plant, at elevation greater than syphon height above low river state, thus simplifying foundations. This is the first inland river plant so built. In 1950–1951 he was vice-president of the Air Pollution and Smoke Prevention Society of America; and has just recently been a member of the U. S. Electrical Utility study group that inspected the power plants of the United Kingdom at the invitation of the British Electricity Authority.

ASME Petroleum Division Plans Seventh Conference

THE Petroleum Division of The American Society of Mechanical Engineers is planning its Seventh Annual Petroleum Mechanical Engineering Conference, at the President Hotel, Kansas City, Mo., Sept. 22–24, 1952.

The Petroleum Division, through these

1952 ASME PETROLEUM DIVISION MEETING EXECUTIVE COMMITTEE

(*Left to right:* N. Miller, H. Grasse, H. A. Smith, J. T. Kimbrell, H. E. Degler, G. M. Pro, R. M. Moon, R. Benninghoven, and H. A. Atwater. Not shown are: A. A. Dahms and C. M. Green.)

annual conferences, affords the mechanical engineers engaged in the petroleum industry an opportunity to discuss in open forum the complex problems encountered in this highly specialized field.

The mechanical aspects of design and operation in the production, transportation, refining, and application of crude petroleum and its products are among the topics to be discussed during the technical sessions at the Kansas City Conference.

The speaker at the luncheon on September 22 will be Edward F. Arn, Governor of Kansas, and R. J. S. Pigott, President, ASME, will be the banquet speaker. The subjects to be discussed at these functions have as yet not been announced.

The scheduled trip to the Standard Oil Company Sugar Creek Refinery will include inspection of the 30,000-bbl-a-day combination crude running and coking unit, the newly completed Administration Engineering and Research Building, and the 250,000-lb-per-hr boiler and auxiliary equipment. A sightseeing trip to the many points of interest in and around Kansas City and its suburbs has also been arranged.

A woman's program, full of interesting things to do, offers luncheons, dinners, a fashion show, a visit to the famous Nelson Art Gallery, and a tour of the city.

The committee in charge of arrangements includes: H. E. Degler, *General Chairman;* R. Benninghoven, *Co-Chairman.* The chairmen of the various subcommittees are as follows: H. Grasse, *Technical Program;* H. A. Atwater, *Hotel;* G. M. Pro, *Finance;* A. A. Dahms, *Reception;* C. M. Green, *Registration;* J. T. Kimbrell, *Publicity;* R. M. Moon, *Entertainment;* H. A. Smith, *Plant Trips;* Mrs. H. A. Grasse, Mrs. H. E. Degler, *Co-Chairman and Secretary,* Women's Activities.

Operations Research Society of America Founded

THE Arden House of Columbia University played host to 75 outstanding scientists from military, university, and industrial establishments who met, May 26, 1952, to found the Operations Research Society of America. This is the first time that experts from such diverse disciplines as physics, chemistry, biology, mathematics, economics, statistics, and the like, have been assembled to pool their knowledge in tackling operational problems which arise in the complex organizations which they represent.

The purpose of this society is to promote the application of operations research, a technique of applying scientific methods to business and military problems. Prof. Philip Morse, of Massachusetts Institute of Technology, was elected first president of the society. Dr. Morse was Director of the Operations Research Group of the Navy during World War II and was decorated with the Medal for Merit by President Roosevelt for his outstanding work in antisubmarine warfare. Dr. Robert H. Rinehart of Case Institute of Technology, who was elected vice-president of the Society, was similarly decorated for his work in the field.

Meetings of Other Societies

Aug. 11–13
Society of Automotive Engineers, national West Coast Meeting, Fairmount Hotel, San Francisco, Calif.

Aug. 12–16
Photographic Society of America, Technical Division convention, Hotel New Yorker, New York, N. Y.

Aug. 19–22
American Institute of Electrical Engineers, Pacific general meeting, Hotel Westward Ho, Phoenix, Ariz.

Aug. 20–28
Eighth International Congress for Applied Mechanics, University of Istanbul, Istanbul, Turkey

Aug. 25–30
UPADI (Pan American Federation of Engineering Societies), third congress, Tulane University, New Orleans, La.

Aug. 25–Sept. 5
International Association for Bridge and Structural Engineering, fourth congress, University of Cambridge (Aug. 25–30) and London, England.

Sept. 3–13
Centennial of Engineering, Chicago, Ill.
(ASME Calendar of Coming Events see page 611)

Other officers elected at the formation meeting were: John B. Lathrop, Arthur D. Little, Inc., Cambridge, Mass., secretary; Dr. Alfred N. Watson, Curtis Publishing Company, Philadelphia, Pa., treasurer.

Professor Morse said, "The formation of the society represents a significant step in the amalgamation of scientific and industrial leadership. The contribution made by the speakers in the first meeting shows that a fruitful combination of sound business practice and the kind of scientific method that made the application of atomic energy possible will open new vistas for industrial and government operations."

The nationwide society will be incorporated in Washington, D. C., and national and regional meetings will be held periodically.

Coming Meetings

International Safety

A BUREAU of Mines technical team from Pittsburgh, Pa., headed by Regional Director H. P. Greenwald, will represent the United States in England at the 7th International Conference of Directors of Safety in Mines Research. Technologists from Great Britain, France, and Germany will participate in discussions regarding research methods and findings in the field of coal-mine safety. The conference will begin July 7 at Buxton, England.

Seven technical papers will be presented at the six-day conference at Buxton by the United States delegates. These will describe tests on the ignition of coal dust and gas (methane) by explosives, various methods of blasting coal, causes and prevention of misfires in explosives, experiments with flameproof enclosures, roof bolting, and use of delayed-action detonators in blasting.

The conference will include visits to testing laboratories and related facilities maintained in England for research in preventing gas and coaldust explosions and other accidents.

Round-table discussions likewise will be held at which American and foreign safety experts will exchange information on timbering techniques, fire hazards, and ventilation methods and problems.

Seminar Slated for Engineering Professors

THE third annual seminar in industrial instrumentation will be held for professors of engineering in Philadelphia, Pa., Aug. 18 to 22, it was announced by the Industrial Division of the Minneapolis-Honeywell Regulator Company.

According to M. J. Ladden, training supervisor for the company's Brown Instruments Division, the five-day program is designed to familiarize the faculty of engineering schools with recent advancements in industrial processes and the attendant development of automatic instrumentation. This phase of engineering, he explained, is covered only on a broad basis in the conventional curriculum. The program will also include discussions of mutual problems of engineering colleges and the instrument industry.

The seminar will be held in the company's training school in Philadelphia.

Industrial Hydraulics

TITLES of six papers to be presented before the technical section of the eighth annual National Conference on Industrial Hydraulics, September 4 and 5, at the Sherman Hotel, Chicago, Ill., have been announced. The conference, sponsored by Illinois Institute of Technology, will be held in conjunction with the Centennial of Engineering.

J. G. Duba, conference secretary and faculty member at Illinois Tech, said that the first two papers of the technical section, scheduled for the first afternoon of the conference, will deal with automotive problems.

C. W. Lincoln, General Motors Corporation, Saginaw, Mich., will speak on "Hydraulic Steering in General Motors Cars," and W. R. Williams, Bendix Aviation Corporation, South Bend, Ind., will discuss "Commercial Vehicle and Passenger Power Braking."

Problems of instrumentation will be treated in two other papers. W. A. Theissen, Standard Oil Company of Indiana, will speak on "Instrument Maintenance in an Oil Refinery." A. A. Kalinske, Infilico, Inc., Tucson, Ariz., will talk on "Air Operation of Hydraulic Gages and Controllers in Water Filter Plants."

The last two speakers will deal with pumps. J. R. English, Denison Engineering Co., Columbus, O., will speak on "Vane-Type Pump Motor Design." Prof. E. L. Midgette, Mem. ASME, Polytechnic Institute of Brooklyn, will discuss "Pump Noises."

U. S. Engineers Are Urged to Publicize Their Work

AMERICAN engineers were urged to tell the U. S. public that engineering genius has been greatly responsible for the differ-

ences in living standards in this country and those to be found in other countries.

The vast benefits the U. S. public has gained from the work of American engineers have gone unrecognized because engineers themselves have not done an adequate job of publicizing their achievements, Hartley W. Barclay, industrial advertising manager of *The New York Times* declared.

Speaking before the annual meeting of the New York City chapter of the New York State Society of Professional Engineers, Mr. Barclay emphasized the need for "broader scale of communications for facts about the values, rewards, results, and practical public gains produced here by engineers."

As examples of some of the major engineering contributions to society, Mr. Barclay cited flood control and waterway improvements; improved transportation and highways; smoke control and combustion efficiency; improved water supply and storage; increased safety in civic and industrial affairs; aviation safety, economy, and expansion; increased power generation and fuel supply; reduced costs of industrial production and material handling; improved communications and understanding of technological progress.

"These are only a few of the scores of major problems with which engineers cope successfully in everyday accomplishments," Mr. Barclay said. "The record of achievements in electronics, chemical engineering, hydraulics, mechanical power transmission, aeronautics, quality control, instrumentation, and other advanced fields is so vast that successful performance of these tasks is taken for granted in this country."

Few persons in the engineering field, however, "have taken time to tell how these gains were achieved, why they were possible, and who made them possible."

Mr. Barclay suggested that if such data were more broadly circulated it might go far "to insure a greater degree of future world-wide economic and social stability and international harmony. •This is true because industry, engineers, and trade in the United States give all of the people practical benefits—benefits which people in other countries of the world can only dimly envisage."

The engineers' task, he continued, is to increase the volume, type, clarity, scope, and effectiveness of their communications about engineering achievements.

To reach these goals, he suggested these steps be taken: Define major new projects for engineering communications; expand the use of available media of the press, radio, direct mail, and public-affairs events; organize adequate staffs for manning communications tasks; use high standards of composition, publication, and distribution; stock-pile and index standard data so that the achievements of engineering may be an "open book" and record for the whole world; and expand effective circulation for developed data.

Mr. Barclay estimated the total audience for engineering information at more than 15 million persons.

"When that audience is reached," he said, "a broader understanding of the results of engineering performances can be expected."

Stress Analysis

PURDUE University, Lafayette, Ind., will offer a two-weeks short course in Experimental Stress Analysis Aug. 4–15, 1952. The course will cover basic fundamentals as well as the latest techniques in the use of strain gages, brittle lacquer coatings, and the application of photoelasticity to enable engineers to find defects in manufactured products.

The course content has been designed particularly for practicing engineers. It will enable interested engineers to become acquainted with the latest developments in the field.

The course will open with a review of the elementary mechanics of materials, followed by the theory and application of electric strain gages to check surface stresses, the calibration and recording of brittle lacquer coatings, and the interpretation of photoelastic stress patterns by the use of plastic models and polarized light.

The short-course will be offered by the University's Division of Adult Education and the School of Civil Engineering and Engineering Mechanics. Enrollment will be limited.

ASME Standards Workshop

Spline Gages

SUBGROUP 1A on Spline Gages and Gaging of Technical Committee No. 13 of Sectional Committee B5 has completed its work on the proposed American Standard Involute Spline and Serration Gages and Gaging. Specifications for gages in this standard are based on American Standards, Involute Splines, B5.15—1950, and Involute Serrations, B5.26—1950.

Subgroup 1A has had numerous meetings and has made wide industry distribution of its proposed standard which is presently with the Sectional Committee for letter-ballot vote.

Chucks and Chuck Jaws

A TENTATIVE draft of the proposed revision of American Standard Chucks and Chuck Jaws dated February, 1952, has been distributed for comment and review to a selected list of organizations and individuals.

This proposal has been prepared by TC 11 on the Standardization of Chucks and Chuck Jaws of Sectional Committee B5 for which the Metal Cutting Tool Institute, Society of Automotive Engineers, National Machine Tool Builders' Association, and The American Society of Mechanical Engineers are joint sponsors under the procedures of the American Standards Association.

At its annual meeting in December, 1948, Sectional Committee B5 voted to revise this standard so that it would include specifications for chucks for Type L Spindle Noses, and voted to make such changes as present-day practice indicates are desirable so that the revision will be a proper companion standard for the standard on Spindle Noses, ASA B5.9—1948. The Foreword and Preface of the proposal sets forth detailed information concerning the development of this project. The specifications for balancing of chucks have been carefully worked out with users and manufacturers.

Anyone wishing to obtain copies of this draft may address a request to The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y., Attention: D. M. Shackelford, Standards Administrator.

Small Solid Rivets

A TENTATIVE draft of the proposed revision of American Standard Small Solid Rivets dated February, 1952, has been prepared by Subcommittee No. 1 on Solid Rivets of Sectional Committee B18 for which the Society of Automotive Engineers and The American Society of Mechanical Engineers are joint sponsors under the procedure of the American Standards Association.

Copies of this draft are being distributed to a selected list of organizations and individuals for review and comment. The suggestions received will form the basis for a redraft to be submitted to the Sectional Committee for its approval by letter ballot.

Anyone wishing to obtain copies of this draft may address a request to The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y., Attention: D. M. Shackelford, Standards Administrator.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, May 20, 1952

A MEETING of the Executive Committee of the Council was held in the rooms of the Society on May 20, 1952. R. J. S. Pigott, chairman, presided.

In addition to Mr. Pigott, there were present: H. R. Kessler, T. E. Purcell, W. F. Thompson of the Executive Committee; E. J. Kates, assistant treasurer; E. G. Bailey, past-president; H. E. Martin, director at large; and C. E. Davies, secretary.

R. A. Sherman, who is abroad, sent a communication expressing his regret that he was unable to attend.

Engineering Societies Personnel Service

The Engineering Societies Personnel Service, Inc., financial report for April, 1952, was noted.

Messrs. Kessler, Martin, and Thompson reported on a visit to the New York Office of ESPS, made recently to review the operation and problems. They felt that while personnel in the office was qualified, a vigorous sales effort was necessary to inform the members of participating societies of ESPS. The secretary reported that the ESPS Board had asked sections of the participating societies to appoint a committee to review ESPS operations.

Applied Mechanics Reviews

A report of the Managing Committee of the status of *Applied Mechanics Reviews* was submitted. According to the report a deficit of well under $5000 can be expected for 1952–1953 as a joint ONR-Air Force contract for $20,000 is now being processed at Wright Field. In addition to this government support, the industrial-subscription program is forging ahead. Thus far four firms have taken industrial subscriptions to the *Reviews* and 14 other companies have shown keen interest. The report, therefore, concluded that for the immediate future a greatly improved and healthy situation exists for the *Reviews*.

ASTM-ASME Contract Procedure

To simplify the present contract procedure for the Joint ASTM-ASME Committee on Effect of Temperature on the Properties of Metals, the ASME was authorized to serve as the contracting agent for such contracts. This will apply to projects and financial campaigns approved by both organizations.

New Section

Upon recommendation of S. D. Moxley, vice-president, Region IV, the establishment of the Miami Section was approved. The area will include the counties of South Florida, Lee, Hendry, Palm Beach, Martin, St. Lucie, Broward, Dade, Collier, and Monroe.

The establishment of the Nashville Subsection of the Chattanooga Section was also approved.

Resolution of Thanks

A resolution was adopted expressing the thanks of the Society to all responsible for the hospitality extended to those in attendance at the Boiler Code Meeting held in Toronto, Canada, recently.

Certificates of Award

Certificate of Award was granted to T. M. Robie, retiring chairman, Oil and Gas Power Division.

Certificates of award were also granted to the following retiring chairmen of Sections: J. F. Cunningham, Jr., Columbus; R. L. Nall, New Orleans; G. W. Beesley, North Texas; C. E. Tyroff, Plainfield; T. M. Spitler, Schenectady; P. E. Darling, South Texas; R. B. Barton, Southern California; and C. A. Meyer, West Virginia.

Certificates of Award were granted to the following past-chairmen of Sections: H. S. Philbrick, 1920–1921, Chicago; H. L. Haworth, 1950–1951, Cincinnati; W. I. Collins, 1950–1951, Pittsburgh; W. H. Chaffe, 1943–1944; J. D. Potter, 1945–1947; G. N. Hodge, 1947–1948; P. N. Fimble, 1948–1949; H. F. J. Skarbeck, 1949–1950; F. C. Frolander, 1950–1951; Plainfield; J. A. Campbell, 1948–1949; R. L. Iglehart, 1949–1950; and W. H. Kassebohm, 1950–1951, San Francisco.

Unity of the Engineering Profession

Mr. Kates reported that Engineers Joint Council had considered the necessary amendments to the EJC Constitution to expand EJC as the first step in carrying out the recommendations of the Exploratory Group. These changes, which require approval of the participating bodies in EJC, will be prepared in detail for submission to the ASME Council before the Cincinnati meeting in June.

1952 Gantt Medal

It was reported that the recipient of the Gantt Medal for 1952 is F. H. Neely of Atlanta, Ga.

C. L. Warwick

The Committee noted with regret the death of C. L. Warwick, secretary of the American Society for Testing Materials, on April 23, 1952.

Appointments

The following appointments on joint activities were approved: Alex D. Bailey (2-year term), Washington Award Commission; J. Carlton Ward, Jr. (3-year term) Guggenheim Medal Board of Award; R. J. S. Pigott, (4-year term) John Fritz Medal Board of Award; William F. Ryan, (3-year term) Engineers' Council for Professional Development.

The following appointments were also approved: R. J. S. Pigott, Hugh L. Dryden, T. E. Purcell, R. H. Bacon, C. E. Davies, Power Show Advisory Committee for 1952; David B. Rossheim, Joint ASTM-ASME Committee on Effect of Temperature on Properties of Metals.

The following presidential appointment was approved: H. B. Oatley, E. L. Robinson, 50th Anniversary of the American Society for Testing Materials.

Joint Meeting With Finance Committee

Upon adjournment of the meeting, the Executive Committee met jointly with the Finance Committee to consider the tentative figures for budget suggestions for the year 1952–1953, and voted to refer the budget to the Council at the Semi-Annual Meeting in Cincinnati, June 15–16, 1952.

Engineers Joint Council Acts on Unity Program

A MEETING of Engineers Joint Council, at which T. G. LeClair, president, presided, was held at the Engineering Societies Building, New York, N. Y., on May 16, 1952.

UPADI Convention

J. M. Todd, chairman of the committee on the 1952 convention of UPADI (Pan-American Federation of Engineering Societies), to be held in New Orleans, La., August 25–30, reported on details of the plans for the meeting. A preliminary program appeared in MECHANICAL ENGINEERING, June, 1952, page 529.) Mr. Todd was named chairman of the U. S. delegation to the convention.

UNESCO

Ralph L. Goetzenberger, EJC representative on the U. S. National Commission for UNESCO, reported on the meeting of the Commission at Hunter College, New York, N. Y., which he had attended, and read excerpts of addresses which he and others had delivered. In his opinion, engineers will become increasingly important in the work of UNESCO, and names of men with engineering background who are willing to serve in Washington on the National Secretariat of UNESCO should be suggested. Gail A. Hathaway referred to the Interdepartmental Water Policy Committee, set up jointly by UNESCO and the Department of State, which is concerned with developing the water resources of the world. This committee is now in the final stages of preparing a paper to be presented to UNESCO. E. A. Pratt, chairman, EJC Committee on International Relations, suggested that EJC's Commission on Technical Assistance be asked to study this subject.

Engineering Unity

Dr. Osborne reported on developments since the last meeting of EJC, March 21, 1952, at which time there was extensive discussion on the Report of the Exploratory Group, which had been sent to members of the Group, together with a request to members outside of EJC for a statement of their probable action if the recommended action is taken and they are extended an invitation to join a unity organization. To date, four societies of the group have not replied. Two societies—The Illuminating Engineering Society and the Institute of Radio Engineers, have stated that they are withholding action at present. The National Society of Professional Engineers has asked some further questions regarding the interpretation of the Exploratory Group's report pending a forthcoming meeting of their governing body. AIEE has given further consideration to its action, and still does not approve the proposals of the Exploratory Group. AIME has taken no definite action. The other seven—ASCE, ASME, AIChE, American Water Works Association, American Association of Engineers, The American Society of Heating and Ventilating Engineers, and the Society of Naval Architects & Marine Engineers—have given favorable replies in response to the request from EJC for preliminary expression of views.

Dr. Osborne read a statement, "Relative Advantages of Different Methods of Representation of Engineering Societies in a Unity Organization," which he had prepared at the request of EJC.

Dr. Osborne read the report of the Committee on Constitution and By-Laws which had been requested to submit for approval suitable changes in the Constitution. The Committee, he said, had proceeded on the general basis of recommendations of the Exploratory Group, i.e., that minimum changes in the Constitution of EJC be recommended at this time, restricting the changes to those considered necessary before issuing an invitation to other societies to join EJC. The Council, after extended discussion, voted: (*a*) To submit to the member societies for approval proposed amendments to the Constitution to provide that the three representatives on the Council from each constituent society shall be appointed by the society from among the officers and members of the governing body of the society at the time of appointment, each representative to complete the term on Council for which he is appointed even though his term as an officer or member of the governing body of the constituent society should end during such term on the Council. (*b*) To submit to the mem-

ber societies for approval proposed amendments to the Constitution to provide for a change in the number of representatives on the Council from each constituent society to "one representative for each 10,000 voting members of the society, or major fraction thereof": the amendments referred to in this paragraph (*b*) to be effective only in case at least four additional societies shall become constituent societies of EJC as a result of (*c*) below. (*c*) To submit to the member societies a list of the other societies represented in the Exploratory Group with a request for a vote in each case as to whether or not such society should be invited to join the Council. (*d*) That the actual wording of the proposed amendments referred to in (*a*) and (*b*) be submitted by the Committee on Constitution and By-Laws to the Executive Committee for final approval before submission to the constituent societies.

National Water Policy Panel

J. H. Ehlers and Thorndike Saville reported that three members of the EJC National Water Policy Panel had presented a statement before the Subcommittee to Study Civil Works (of House Committee on Public Works). There was also presented for the record a "Summary of Developments in the Field of National Water Policy—Six-Month Period—April 1, 1952," which had been sent to members of the Panel by its chairman, W. W. Horner.

Manpower

T. A. Marshall, reporting for Donald S. Bridgeman, secretary, EJC Special Surveys Committee, gave some preliminary figures resulting from a survey currently being conducted. Preliminary returns from 223 companies which employ about 1.5 million persons, of whom 58,000 are graduate engineers, indicate that they will need 7500 graduates from this year's classes and 2600 additional experienced engineers.

Mr. Marshall said that EJC Engineering Manpower Commission is planning a report, "Manpower Utilization and National Security," for presentation at a conference to be held in Chicago, Ill., during the Centennial of Engineering. This conference is scheduled for Sunday, Sept. 7, 1952, in the Grand Ballroom of the Conrad Hilton Hotel. The report, which will be presented by Carey H. Brown, chairman, Engineering Manpower Commission of EJC, "will highlight the position of EMC with respect to such important manpower problems as Universal Military Training, Universal Military Service, Expanded ROTC proposals, unified Reserves legislation, Selective Service, and industrial utilization of specialized personnel in short supply."

Salary Stabilization

W. N. Carey read excerpts from a letter, April 21, 1952, written by the special EJC committee (Gail A. Hathaway, E. G. Bailey, and Carlton S. Proctor) to the Committee on Banking and Currency, U. S. Senate, which stated the opinion of EJC on the Bricker amendment (S.2645) to the bill for extending the Defense Production Act, "which proposes to exempt certain professional engineers and architects from the salary-regulating provisions of the Act."

Centennial of Engineering

E. L. Chandler reported progress on the Centennial of Engineering to be held in Chicago, Sept. 3–13, 1952, in connection with the one-hundredth anniversary of the founding of the American Society of Civil Engineers.

World Power Conference

The Council voted to accept the Secretariat for the U. S. National Committee on the World Power Conference.

Junior Forum

Conducted by Joseph Schmerler[1]

Mechanical Engineers in Electric-Utilities Industries

GRADUATES in mechanical engineering this year report that while numerous jobs have been offered them, the range of positions is not restricted to those which might normally be considered in mechanical-engineering industries. It appears increasingly evident that a mechanical-engineering education can be applied to a variety of fields.

What jobs, for instance, are offered mechanical engineers in the electric-utilities industry? To answer this question, we have abstracted a talk presented to the student members of ASME at The Johns Hopkins University on Feb. 18, 1952, by Samuel B. Sexton, 3rd, Mem. ASME, executive assistant, Safe Harbor Water Power Corporation, Baltimore, Md., and also a letter written for the Junior Forum by John D. Mayhoffer, Jun. ASME, who is employed by a public utility.

Mr. Sexton found that because of the increasingly high steam pressures and temperatures and the complex nature of auxiliary equipment of today's steam power plant, situations arise which only trained mechanical engineers are competent to handle. There is a continuing need for mechanical engineers to solve engineering problems and plan new construction. In a sense every new installation these days is an experiment. Mechanical engineers are needed to evaluate operating data of the equipment and decide which to retain or what changes to make. Supervision of the operation and maintenance of such plants is leaning more and more to the graduate mechanical engineer. The superintendent of most large steam stations is usually a graduate mechanical engineer. In many large stations the plant is never finished in the true sense of the word. New problems are constantly arising.

Correct boiler-water treatment and problems in metallurgy offer a challenge to the mechanical-engineering graduate. Modern electric-utility companies employ ever-increasing numbers of engineers in the test department for making boiler, turbine, evaporator, and condenser tests. Work of this character involves planning, data taking, working up results, and ultimately writing a final report of the test.

Replacement of old equipment and expansions due to increasing loads, afford opportunities for mechanical-engineering graduates, in the electric utilities, to expedite the procurement of mechanical equipment of all kinds, to act in various inspection capacities, and frequently to visit factories to check on specification adherence and on delivery of vitally needed new material. Erection of equipment in a station is often supervised by mechanical engineers as is the lining-up and final inspection of new equipment. Some companies have their own engineering department where plans and specifications are made or checked for most of the equipment and property.

In hydroelectric stations mechanical engineers find opportunities to improve the operation of hydraulic turbines, gate-operating devices, and governors. The welding of pitted or eroded areas on the turbine blades has taken on extreme importance. The welder needs the supervision of a trained engineer in selecting proper welding materials and technique. Problems arise in connection with bearings and lubricating oils, all of which are recognized fields for mechanical engineers. Frequently the mechanical engineer is called upon to develop some new testing procedure or testing equipment.

Opportunities for mechanical engineers do not stop in the generating stations of the utility companies. Today it is regular procedure for electric-utility companies to employ mechanical engineers in accounting, personnel, and even purchasing departments. The complexity of the business is such that the ultimate ends of accounting, personnel, and purchasing are better-integrated with the over-all operation of the company by having technically trained persons in these departments. The graduate who has leanings toward business will find opportunity in these departments.

The average electric-utility company has an industrial-power sales department which, as its name implies, deals with the large industrial power users. This is another opportunity for mechanical engineers. Power is sold by suggesting new production methods and being able to justify them economically. The engineer is called upon to handle dealings with the customer in utilization of power, interpretation of power contracts, recommendation of improvements in utilization of electricity in the manufacturing processes, and a certain amount of original engineering. Such mechanical engineers must be familiar with the

[1] Design Engineer, Celanese Corporation of America, New York, N. Y. Jun. ASME.

latest machine-tool equipment, conveyer equipment, and heat-treating methods, to name a few of the industrial uses of electricity.

The administrative side of an electric utility employs mechanical engineers at almost every level of management. Power contracts have to be negotiated and the engineer works hand in hand with the legal staff. Mechanical engineers, with a knowledge of plant equipment, its operation, and capabilities, will find opportunities here. Some utilities have what might be called an efficiency department or economy department for the purpose of scheduling, economically, the generating equipment in the system with consideration for the relative operating costs of each piece of equipment.

Engineering know-how invades every portion of the electric-utility industry. A full rounded experience in the various phases previously mentioned is excellent preparation for important supervisory positions which inevitably lead to one or more positions in management. In a survey a few years ago it was found that about three fourths of the men at management level in the electric-utility industry started in the engineering divisions of the companies. Many utilities are today guided by presidents who started as mechanical engineers.

The following report of specific activity in the electric-utility industry has been written for the Junior Forum by John D. Mayhoffer, Jun. ASME, to isolate one segment of this industry which was described broadly by Mr. Sexton:

The public utility, with which I am associated, employed me as an assistant engineer in the transmission hydro production department. My indoctrination period lasted three months and consisted of making wire diagrams for substation switchboards. While this training period previously lasted one to three years, the pressing need for field engineers dictated that I be assigned to more responsible work after only a short indoctrination in the electric-utility field. I was transferred to the transmission department where I worked with a surveying crew on the construction of transmission lines. This phase of my work lasted a year and a half and consisted of mapping, profiling, locating routes, and setting transmission-line towers and fixtures.

When transmission-line construction slackened I was reassigned to the substation section of the transmission hydro production department. This was in line with a new program to familiarize the junior engineers with the many departments and operations of the company. For nine months I was able to view firsthand the complete operation of all departments connected with the generation and sale of electric power.

After this training program I returned to my original section where I am now engaged in construction of substations for both transmission and subtransmission.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th Street	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

Men Available[1]

Plant Engineer, 41, ME, MS in ChE, 15 years' engineering, power, maintenance, construction, supervision, costs, in chemical industries. Interested in plant-engineering or administrative position. Me-883.

Plant Manager, executive, thorough college training in basic engineering and 23 years' broad experience in management with three nationally known companies, including all phases of industrial engineering and plant management. Me-884.

Production Manager (assistant), BSME in IE, MSBA almost completed, 27, two years' diversified experience with electronic computers. Presently highly responsible liaison engineer and administrative engineer. Prefers large Eastern city. Me-885.

Power Engineer, 38, eight years industrial power-plant operation; six years service engineer major turbine manufacturer; four years steam-plant startup engineer major engineering construction firm; one year consulting mechanical-engineering work. Desires power superintendent position. Me-886.

Material-Handling and Packaging Engineer 30, married; BSME, MSIE; four years' extensive experience in storage, shipping, and packaging methods, including package testing, government specifications, etc. Presently in supervisory capacity with national organization. Desires to relocate East. Me-887.

[1] All men listed hold some form of ASME membership.

Positions Available

Liaison Engineer, 25–30, some experience in design, production, and testing of refrigeration or air conditioning equipment. $5000–$7500. Pa. Y-7093.

Assistant Professor or Instructor to teach kinematics, mechanics, heat-power courses in the mechanical-engineering department of an accredited college. Rank and salary dependent upon qualifications. Liberal policy in granting leave of absence on half salary to qualified instructors who wish to do graduate work. East. Y-7094.

Manufacturer's Representative for the Atlantic Seaboard, for sale of centrifugal separators. Must have thorough understanding of process equipment and have previous experience in selling this equipment to these industries. $5000, plus commission and expenses. Y-7095.

Project Engineers. (*a*) Project engineer, BSME or equivalent, and about five years' experience, to direct development of new electromechanical system involving gyroscopes and switching circuits. Must be able to supervise one junior engineer and two technicians. $5265. (*b*) Project engineer, BSME or equivalent, and about five to seven years' experience, to design mechanical components of gyro systems, such as motor housings, contacts, bearings, caging mechanisms, etc. $5265–$6812. N. J. Y-7098.

Engineers. (*a*) Staff engineer, industrial graduate, 30–38, at least six years' experience in food or general manufacturing covering wage incentives, standards, cost programs, etc. $7000–$8500. (*b*) Cost-installation engineer or accountant, under 40, to supervise cost work in manufacturing and distribution plants of food-products manufacturer. $6000–$7000. Considerable traveling. Headquarters, New York, N.Y. Y-7100.

Production Manager, 35–50, mechanical graduate, at least five years' aircraft-aluminum or other light-metal-fabricating experience, to supervise production and liaison engineering covering frame sections and accessories. $8000–$10,000, plus bonus. Conn. Y-7102.

Mechanical Engineer, 40–50, heavy and varied experience, including steam-power plants, water plants, air conditioning and ventilation, and similar problems in industrial construction and design, preferably in the chemical industry. Md. Y-7105.

Manufacturing Engineer, 40–50, degree in mechanical engineering, and at least five years' experience as a manufacturing engineer and a broad knowledge of materials such as brass, aluminum, die castings, stainless-steel sheet, and plastics. Should preferably be familiar with engineering administrative procedures, and served actual apprenticeship in tooling. Will be responsible for modification of design of new products, redesign or modification of design of present products, tooling, estimating; some methods engineering, including some plant layout, etc. N. J. Y-7106.

Supervising Process Engineer, considerable experience in methods, operation writing on small stampings and instruments. Completely experienced in screw machines and light presswork. $8000–$8500. Northern N. J. Y-7110.

Assistant Mechanical Supervisors, 25–35, graduates, several years' experience in maintenance work, and some machine-shop experience, for work involving a knowledge of packaging equipment, bakeshop equipment, refrigeration, and general factory maintenance. Salary open. New York, N. Y. Y-7120.

Mechanical Engineer, 35–40, graduate, at least ten years' power and process-plant engineering experience, preferably in sugar refining or allied industry, for supervision of equipment engineering, installation, and operation. $10,000–$12,000. Cuba. Y-7122.

Packaging Engineer, 25–45, training in industrial design, commercial art, or engineering required, and five years' experience in the design and production of packaged products desirable. Familiarity with automatic machinery required. Extensive experience with all kinds of packaging materials necessary. Will design and make samples of packages to meet a variety of requirements. Test packages in production and shipment. Draft specifications with consideration for mechanical production, cost, and protection of product. $5640–$7440. N. Y. Y-7129.

Mechanical Engineer for fabric research. Must have ME degree, experience in the textile field designing mechanisms. A nongraduate will be considered if he has had at least three years' textile-machine design experience with a record of having developed new fabrics or yarns by the use of mechanical devices. New York metropolitan area. Y-7130.

Research and Development or Design Engineers, two to ten years' experience in air-compressor design, test, manufacturing, and service. $5000–$10,000. Northern N. J. Y-7132.

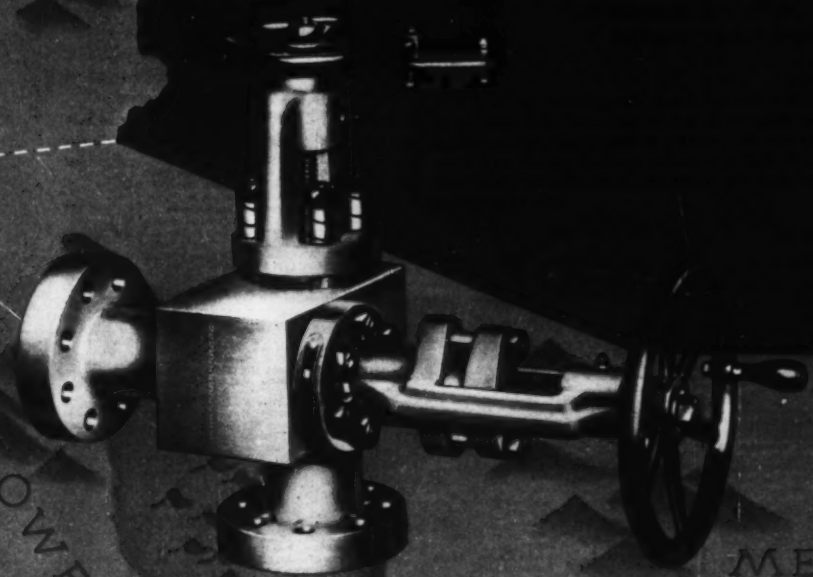
Production Superintendent, mechanical graduate, at least five years' supervisory shop experience covering industrial valves, forgings, castings, pipe accessories, etc. $7500. Western Pa. Y-7133.

Engineers. (*a*) Methods analyst to set up assembly lines. Must have good commercial

(*ASME News continued on page 620*)

ALSO IN ARIZONA, IT'S YARWAY

YARWAY UNIT TANDEMS



YARWAY SERVICE GOES ALL THE WAY....

practice and experience on time and motion studies, wage incentives, etc. (*b*) Industrial engineer familiar with plant layout, material handling, plant facilities, etc. $5000–$7000. Northern N. J. Y-7136.

Assistant Chief Engineer, 30–40, with ME degree and several years' experience in electro-mechanical controls. Specialized experience in solenoid valves highly desirable, but not essential. Must be able to initiate projects and carry through to completion for nationally known manufacturer. Midwest. Y-7137.

Chief Engineer, 40–50, at least five to ten years' experience in charge of design, product development in business-machine field. Must have some knowledge of electronic control apparatus. $12,000–$15,000. Brooklyn, N. Y. Y-7139.

Engineers. (*a*) Cryogenics engineer, 25–30, BS or MS in mechanical engineering, with two to three years' experience in development field for work on low-temperature refrigerator development. Background must include experience in designing heat-transfer systems rather than relying on standard types. Should also have machine-design experience as work will include theoretical study and refrigerator development. (*b*) Mechanical engineers, under 30, interested in the design of small devices. Should have BSME with good scholastic standing, and two to five years' industrial experience, involving mechanical-engineering design, fabrication, properties of materials. Design experience or development work on a variety of small metal components. Mass. Y-7141.

Product and Process-Development Engineer, to 40, at least a degree in mechanical engineering and five to ten years' experience in product and process development primarily in mechanical instruments, jewelry, or related type of work. Must be completely familiar with metal forming, finishing, and assembly operations. Will assist chief engineer in working on new projects. To $8500. Conn. Y-7144.

Mechanical Engineer, minimum of four years' experience in plant engineering, to handle work in maintenance department. Duties consist of co-ordinating, auditing, and analyzing the procurement and distribution of all plant utilities including electric power, natural gas, water, steam, compressed air, and fuel oil. Also assignments on construction, rearrangement, and installation projects other than those predominantly electrical, as well as domestic and waste-water treatment. $4800–$6000. Ohio. Y-7149.

Power-Plant Superintendent, 35–40, at least five to ten years' good experience, to assume complete responsibility for a power department, including a number of boilers of different descriptions, two turbogenerators of 7500-kw and one of 1250-kw, a water-treating plant, a river pumping station, and various similar equipment with supervision of shift foremen and operations. Salary open. Y-7161(*a*).

Teaching Personnel. (*a*) Assistant or associate professor to teach graduate and undergraduate courses in heat transfer and allied subjects. Also to initiate and conduct research in these fields. Should have publication and society activities. About $7060 on a nine-month basis. (*b*) Instructor to teach undergraduate thermodynamics and laboratory, or machine design and kinematics. About $4000 on a nine-month basis plus remission of tuition for graduate work. New York metropolitan area. Y-7171.

Recent Graduate Engineers. (*a*) Recent graduate for operating division of a large oil company, eventually to be responsible for repair of equipment, design, construction, and maintenance of service stations, etc. $4068, while training in New York; eventual location, Far East. Will accept married man with no children. (*b*) Recent graduate, preferably mechanical, must be single for training as lube-oil salesman for the Far East. Training in New York for six months. While training, $4080. Three-year contracts, six-months' vacation leave at end of contract. Y-7174.

Industrial Sales-Development Engineer, degree in mechanical, chemical, or biological engineering and some experience as an industrial salesman, preferably in food-processing or heavy chemical equipment. Position will include technical sales development and engineering in its function. Company manufactures equipment for hospitals and medical profession. After employment will be given an extensive 10 or 12-week indoctrination course. Pa. Y-7179.

Assistant or Associate Professor, 30–45, master's or doctor's degree in mechanical engineering, registered professional engineer, or eligible for registration. Experience in both teaching and industry with specialization in machine design, to reorganize and direct the machine-design sequence of courses. Experience or familiarity with co-operative plan of engineering education required. Publication of technical books or papers with emphasis on instruction and research desired. Appointment on 12-month basis with one full month of vacation in summer. Salary open. Middle West. Y-7181.

Manufacturing Vice-President, 40–42, college graduate, preferably ME degree. Must have firsthand and direct knowledge of sheet-metal fabrication, i.e., gages 18-in. or lighter. Sales experience not necessary but would be helpful. Will be responsible for the operation of the plant. $18,000–$20,000, with profit-sharing arrangement. Middle West. Y-7185.

Industrial Engineer for survey and plant layout on medium and heavy machine tools and equipment for consulting management engineers. Must be able to meet clients and present good reports. $9000. New York, N. Y. Y-7186.

Sales Engineer, at least one year's experience in industry with chemical-process equipment, for the sale and application of equipment such as heat exchangers, condensers, evaporators, etc. Sales experience not necessary but would be helpful. To $8500, depending upon experience, plus expenses. Travel about 50 per cent of time. Eastern territory. Headquarters, New York, N. Y. Y-7189(*a*).

Chief Engineer, 35–40, at least four years' experience in appliance manufacturing, auto-parts, or farm-equipment manufacturing. Knowledge of heat-treating and deep-draw dies. Will take charge of engineering for heavy stampings and metal fabrications for a manufacturer of metal products. To $12,000. Chicago, Ill. R-8910.

Sales Distributor, preferably mechanical graduate, 30–50; at least five years' experience, preferably with some field sales in Kansas City territory on equipment such as power transmission or connected machinery; cement-mill kilns, conveyers, etc.; speed reducers, gears, pulleys, roller-bearing pillow blocks, and combinations of such items. Fair effort should produce $7000–$10,000; agreeable to company to distribute other noncompetitive items. Kansas City, also Denver; car required; considerable traveling. R-8922.

Designers, 30–50, at least four years' experience in designing or laying out foundry equipment, material-handling systems, or sand handling. Bulk-handling background of any kind may be acceptable. Will design and lay out mechanized foundries and equipment. Consulting engineers for foundries. $6000–$9600. Employer may negotiate fee. Chicago, Ill. R-8926.

Machine Designer, preferably mechanical-engineering graduate, 30–50; five years' experience in special metalworking machinery, adaptation of standard production machinery to special functions. Knowledge of metalworking. Will design special production machinery, principally of a mechanical nature but occasionally with electrical and electronic controls. Knowledge of what controls can be used more important than ability to design such controls. To $7200. Employer will negotiate fee. Chicago, Illinois. R-8951.

Instructors, assistant or associate professor, and industrial engineers with master's degrees. Must have practical experience in industry and some teaching experience. Mechanical engineer must be heavy on heat, power, heat transfer, air conditioning, refrigeration, etc. Openings available in September, 1952. $3200–$6000. Midwest. D-7783.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after July 25, 1952, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

BAGGALEY, WALTER, Beirut, Lebanon
BRADFORD, A. NELSON, Penn Yan, N. Y.
BRADLEY, FRANK L., JR., Ridgewood, N. J.
BRENNEMAN, WALLACE D., Lima, Ohio
CAMPO, JULIO H., Bogotá, Colombia, S. A.
CAVELL, W. E., Guelph, Ont., Can.
CHAMBERS, WILLIAM V., Reading, Ohio
COCHRANE, ROBERT B., JR., Albany, Calif.
COCO, SAMUEL B., JR., Pampa, Texas
COOK, EDWARD M., Massillon, Ohio
CORT, AMBROSE, JR., New York, N. Y.
CRISTIANI, ABELARDO, Mexico, D. F., Mex.
CUNNINGHAM, JOHN W., Decatur, Ga.
DALY, JAMES L., Kansas City, Mo.
DANBERG, CHARLES, Mattapan, Mass.
DEAN, HUGH G., Irvington-On-Hudson, N. Y.
DREW, FRANKLIN H., San Francisco, Calif. (Rt&T)
DUNAWAY, JASPER, L., Dallas, Texas
DUNCAN, J. R., Ottumwa, Iowa
EDGAR, CARROLL, Boise, Idaho (Rt&T)
ENZMAN, SIEGMUND, Racine, Wis.
FELGAR, DONALD N., Alliance, Ohio
FINNE, GILBERT L., South Plainfield, N. J.
FORBES, H., Burke, White Plains, N. Y.
GARDEN, JOSEPH, Cleveland, Ohio (Rt&T)
GRAY, GRANT, H., Cranston, R. I.
HALDENWANG, JOHN E., Bayonne, N. J.
HALLAM, ROBERT M., Springfield, Mass.
HEDGES, J. S., Lima, Ohio
HOGBERG, AKE O. B., Worcester, Mass.
HOLMES, JAMES R., Vicksburg, Miss.
HOWE, KENDALL C., Seattle, Wash.
HUDELSON, GEORGE D., Columbus, Ohio
JACOBS, JULIAN H., Chattanooga, Tenn.
JENIKE, ANDREW W., Salt Lake City, Utah
JOHNSON, ROBERT R., Minneapolis, Minn.
JOHNSTON, JOHN, JR., Wilmington, Del.
JORDAN, HAROLD J., Lynnfield Center, Mass.
KAHLENBERG, JAMES F., Sarasota, Fla.
KIRK, EDWIN R., Raleigh, N. C.
KOWALSKY, WILLIAM, New York, N. Y.
LANDMANN, C. R., New York, N. Y.
LEWIS, THOMAS E., JR., Trombull, Conn.
LONGOBARDO, GUY S., Wilmington, Del.
MALLOY, THOMAS B., SR., Bronx, N. Y.
MALONEY, WILLIAM, J., Amsterdam, N. Y.
MANCHA, A., London, England
MAYER, PAUL M., Highland Park, Ill.
MERRITT, HARRY C., Downingtown, Pa.
MILLER, DONALD F., Pittsburgh, Pa.
PARKER, JOSEPH E., Texas City, Texas
PETERS, EDWARD L., University Park, Md.
PLATNER, JAMES B., Atlanta, Ga.
PLUMB, R. F., Cedar Rapids, Iowa
PURCHASE, ALAN, Menlo Park, Calif.
RADFORD, JAMES E., Washington, D. C.
RAYMUNDO, JOSE E., Oakland, Calif.
REINTGEN, ROBERT J., Latrobe, Pa.
RICKERT, PAUL H., Reading, Pa.
RIONEY, F. GERALD, Elmhurst, N. Y.
ROURKE, WALTER R., Euclid, Ohio
RURLING, C. J., JR., Albuquerque, N. Mex.
SAWYER, CHARLES F., JR., Latrobe, Pa.
STIPE, WALTER H., Dixon, Calif.
STOUT, GEORGE S., Jeannette, Pa.
STUDENT, KURT R., Lakewood, Ohio
TEVES, FRED W., New York, N. Y.
TYREE, WILLIAM D., Nashville, Tenn.
VELLETRI, ANDREW, Saunderstown, R. I.
WALKER, DAVID W., Fort Monmouth, N. J.
WHARFF, PRENTICE C., JR., Berkeley, Calif.
WOMBACHER, BURKE W., Peoria, Ill.
WRIGHT, WARREN W., Calistoga, Calif.
YARUS, HOWARD V., Dahlgren, Va.
ZIRN, B. HOWARD, Brooklyn, N. Y.
ZUDANS, ZENONS, São Paulo, Brazil, S. A.

CHANGE IN GRADING

Transfers to Member and Associate

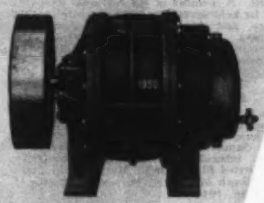
BRASHEAR, WILL M., Berkeley, Calif.
BRYANS, HENRY T., Wayne, Pa.
BURKHARDT, JOHN B., Chicago, Ill.
CANALIZO MADERO, VALENTIN F., Mexico, D.F., Mex.
HEROD, W. R., New York, N. Y.
HOFFMAN, WRAY M., Swarthmore, Pa.
JACKSON, THOMAS W., Dayton, Ohio
KAHN, HERMAN, Brooklyn, N. Y.
KELLER, H. S., Jackson, Mich.
KELLY, RAYMOND E., Panama City, Fla.
KETCHUM, GARDNER M., Schenectady, N. Y.
MANGAN, JOHN L., St. Louis, Mo.
MILLER, FRANK D., Rockford, Ill.
MYERS, CHARLES L., JR., Lansdale, Pa.
ROSENBUSH, FRED M., West Hartford, Conn.
SAWYER, FRED A., Boston, Mass.
STERN, F. B., JR., Houston, Texas
THEILHABER, J. THOLA, Flushing, N. Y.
WEBSTER, JOSEPH F., Bethlehem, Pa.
WILSON, JOHN G., Littleton, Mass. Y.
WOLF, ARNOLD M., Brooklyn, N. Y.
WOLFF, JOHN F., JR., Jenkintown, Pa.

Transfers from Student Member to Junior.....500

(*ASME News continued on page 622*)

For 10 CFM or 100,000 CFM ...compare blower values

ROTARY



Typical low-capacity R-C Rotary Positive Blower. Sizes range from 5 cfm to 50,000 cfm, permitting selection closely matched to needs.

- ☐ Choice of Rotary or Centrifugal
- ☐ Capacity matched to the job
- ☐ Easy accessibility
- ☐ Ruggedness
- ☐ Ease of installation
- ☐ Ability to handle overloads
- ☐ Long-time durability
- ☐ Freedom from breakdowns
- ☐ Low maintenance costs
- ☐ Engineering assistance
- ☐ Proved reputation of maker
- ☐ Customer satisfaction

No need to take chances when buying blowers, exhausters or gas pumps. Just put this "detector test" to work on your specific problem and you'll arrive at the most satisfactory answer.

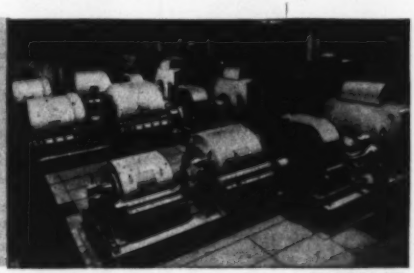
For instance, if you're debating between Rotary Positives and Centrifugals, remember that only Roots-Connersville builds both—the exclusive *dual-ability line* that permits unbiased recommendations. Their wide range of capacities supplies sizes and types that are quite likely to be most closely matched to your needs.

For economy of operation, reliability and low maintenance, we refer you to a list of users that dates back almost a century. If you'll rate your possible choices on a performance basis, you'll usually find R-C equipment "tops" on the list.

To help you make the most profitable, practical decision, our experience is at your service.

ROOTS-CONNERSVILLE BLOWER DIVISION
525 Michigan Avenue, Connersville, Indiana

CENTRIFUGAL



Six R-C Multi-Stage Centrifugal Blowers equipped with automatic regulators to provide extremely wide range of operation at various pressures and capacities.

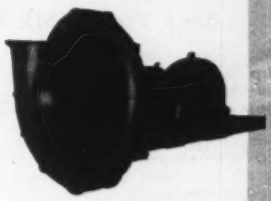
Reg. U.S. Pat. Office

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC

THE *DUAL-ABILITY* LINE OF MODERN EQUIPMENT TO HANDLE GAS AND AIR

Multi-Stage Centrifugal Exhausters



Single-Stage Centrifugal Blowers

Rotary Positive Blowers

Rotary Positive Gas Pumps

Positive Displacement Meters

Inert Gas Generators

Obituaries

Howard Becker (1926–1952)

HOWARD BECKER, mechanical engineer, Eastern Engineering Co., New York, N. Y., died Feb. 17, 1952, in an automobile accident. Born, Brooklyn, N. Y., April 16, 1926. Parents, Morris and Pauline Becker. Education, BME, The Cooper Union School of Engineering, 1949. Jun. ASME, 1949. Survived by parents and a sister, Mrs. Lucille B. Maslin.

Harmon Francis Fisher (1885–1950)

HARMON F. FISHER, chief engineer, Project 20, Sunnyvale (Calif.) Works, Westinghouse Electric Corp., died April 21, 1950, according to a report recently received by the Society. Born, San Francisco, Calif., Oct. 11, 1885. Education, BS in hydraulic and electrical engineering, University of California, 1909. He was the author of several technical reports and papers and held many U. S. Patents. Mem. ASME, 1948.

Taylor Hale (1920–1950)

TAYLOR HALE, Captain, Air Force, died Sept. 7, 1950, at Keesler A.F.B., Biloxi, Miss. Born Jamesport, Mo., April 23, 1920. Parents, James H. and Iva Mae Hale. Education, BS(ME), The University of Nebraska, 1948. He received the Air Medal with 7 Oak Leaves, 1944–1945, South Pacific Area. Jun. ASME, 1948. Survived by parents and a brother, Dr. Ralph Hale, Kansas City, Mo.

Charles Ellison MacQuigg (1885–1952)

CHARLES E. MACQUIGG, dean and director, engineering college, the Ohio State University, died April 24, 1952. Born, Ironton, Ohio, Jan. 19, 1885. Parents, Charles B. and Rosa (Ellison) MacQuigg. Education, ME, Ohio State University, 1909; hon. DE, Clarkson College of Technology, 1946. Married Lillian Rodgers, 1912. Mem. ASME, 1947. He was president of the American Society for Engineering Education, 1947–1949. A member of the National Research Council, he held several patents on metallurgical inventions, and was author of numerous technical papers. Survived by wife and three sons, Major David E., Fort Reilly, Kan.; Dr. Roger E., Albuquerque, N. Mex.; and Charles H., Dallas, Texas.

Earle Mauldin (1885–1951)

EARLE MAULDIN, Southern editor, McGraw-Hill Publishing Co., Inc., Atlanta, Ga., died Oct. 10, 1951. Born, Greenville, S. C., Nov. 20, 1885. Parents, Samuel and Ida Louise (Harrison) Mauldin. Education, AB, Furman University, 1905. Married Elizabeth K. Martin, 1911; children, Elizabeth M., Earle, Jr., and Harriette H. Mem. ASME, 1940.

James Daniel Mortimer (1879–1952?)

JAMES D. MORTIMER, whose death was recently reported to the Society, was at one time president of The North American Co., The Milwaukee Electric Railway and Light Co., The St. Louis County Gas Co., and others. Born, Elmhurst, Ill., Nov. 23, 1879. Education, BS, University of California, 1900. He was the author of numerous articles published in technical periodicals. Mem. ASME, 1920.

Eric Plagwit (1875–1952)

ERIC PLAGWIT, manager, Chimney Division, The Rust Engineering Co., Pittsburgh, Pa., died April 13, 1952, of injuries sustained during a six-alarm fire. Born, Berlin, Germany, Aug. 31, 1875. Education, 3 years, Royal Technical High School, Berlin. Married Emilie Plagwit (died 1944). Married 2nd, Dolores Medina de Plagwit, 1951. Mem. ASME, 1918. Survived by wife, a stepson, Adolph Bishoff; a brother, Richard, and a niece, Lilli.

Frederic Charles Rudolph (1904–1952)

FREDERIC C. RUDOLPH, civil and mechanical engineer, Parsons, Brinckerhoff, Hall & Macdonald, New York, N. Y., died Feb. 22, 1952. Born, New York, N. Y., July 17, 1904. Parents, Charles F. B. and Virginia (Phillipi) Rudolph. Education, 3½ years, Stevens Institute of Technology. Married Georgie Anna Plummer, 1935. Mem. ASME, 1937. Survived by wife and a sister, Mrs. Luz R. Simpson, New York, N. Y.

Robert Lewis Thomas (1914–1952)

ROBERT L. THOMAS, industrial engineer and training director, Minneapolis-Moline Co., Minneapolis, Minn., died Jan. 28, 1952. Born, Milwaukee, Wis., July 8, 1914. Parents, Edwin R. and Anna (Woellert) Thomas. Education, BSIE, Purdue University, 1935. Married Irene Dee, 1939. Jun. ASME, 1938; Mem. ASME, 1950. At the time of his death, he was serving as vice-chairman, Minnesota Section, ASME. Survived by wife, who is chairman, Minneapolis Section, Woman's Auxiliary to the ASME.

August Ulbert (1899–1949)

AUGUST ULBERT, Eastern manager, Alco Valve Co., New York, N. Y., died Dec. 6, 1949, according to a report recently received by the Society. Born, Hockanum, Conn., Oct. 7, 1899. Education, two years, Trinity College; one year, Northeastern College. Married Esther Brown. Jun. ASME, 1942. Survived by wife.

Harry Thurber Woolson (1876–1952)

HARRY T. WOOLSON, retired executive engineer, Chrysler Corp. and former president, Chrysler Institute of Engineering, died in St. Petersburg, Fla., March 23, 1952. Born, Passaic, N. J., Sept. 20, 1876. Parents, George C. and Sarah M. (Thurber) Woolson. Education, ME, Stevens Institute of Technology, 1897. Married Bessie Van Iderstine, 1903. Mem. ASME, 1907; Fellow, ASME, 1946. He was awarded the Stevens Institute medal for accomplishments in engineering, 1945; two citations from U. S. Army Ordnance Department. President of SAE, 1937. Survived by wife and three sons, L. Irving, G. Thurber, and Herbert C.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult reverse side of card for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting your address, business connection, and Professional Divisions enrollment is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

New Membership List in Preparation

Please be sure to include your present business title and name of company. See box below.

ASME Master-File Information

(Not for use of student members)

Please print — **Check mailing address**

Name ..... (Last / First / Middle)

Home address ..... ☐ (Street / City / Zone / State)

Name of employer .....

Address of employer ..... ☐ (Street / City / Zone / State)

Product or service of company .....

Title of position held .....

Nature of work done .....

Please register me in three Professional Divisions as follows:

1 .....

2 .....

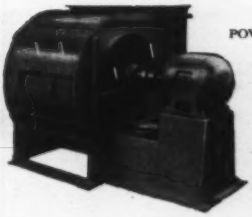
3 .....

(Processing of address change requires four weeks)

I am a subscriber to (please check)

Transactions ☐ Journal of Applied Mechanics ☐ Applied Mechanics Reviews ☐

AXIAL FLOW FANS



POWER PLANT FANS

BREEZO FANS

LIMIT-LOAD FANS

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75 years of building dependable air handling equipment

TYPE "CB" PRESSURE BLOWERS

BELTED VENT SETS

TYPE "CC" PRESSURE BLOWER

RE BLOWERS-EXHAUSTERS

Efficient Air Handling Units
To Satisfied Customers
Since 1877

We welcome the opportunity to solve *your* problem.

BABY CONOIDAL FANS

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SHORTBOY VENTILATING SETS

FIRST FOR FANS

BUFFALO "Buffalo" FORGE COMPANY

148 MORTIMER ST. BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

VENTILATING | PRESSURE BLOWING | AIR CLEANING | COOLING | AIR TEMPERING | HEATING | INDUCED DRAFT | FORCED DRAFT | EXHAUSTING

JENKINS PRACTICAL PIPING LAYOUTS 61

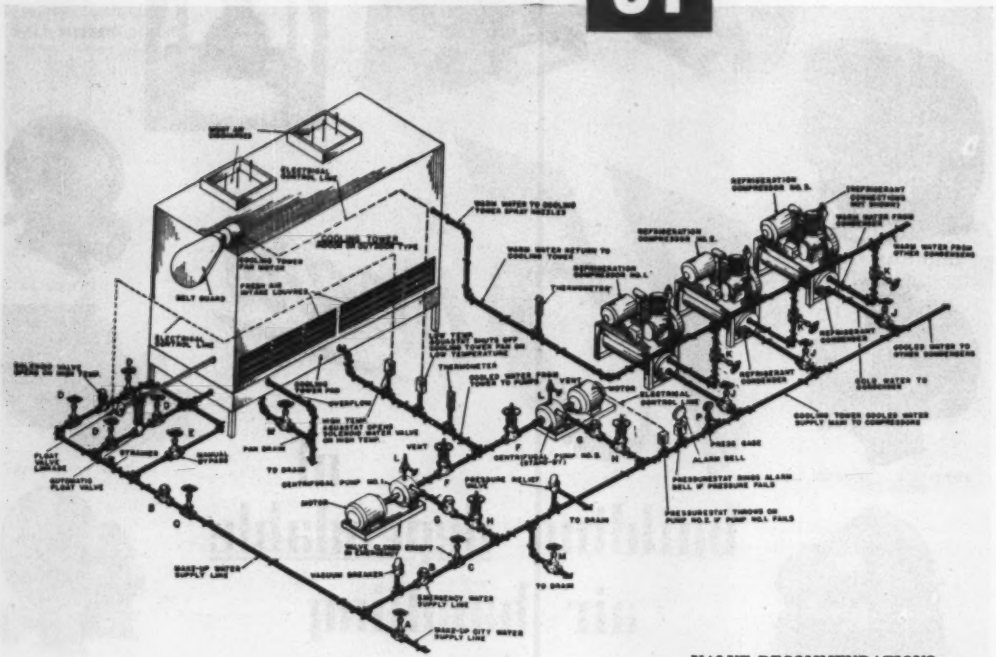

Diagram by Huxley Madeheim Consulting Engineer

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How to plan a COOLING WATER SYSTEM FOR REFRIGERATION COMPRESSORS

Facilities for cold storage of frozen and perishable foods in super markets, hotels, restaurants and institutions are being expanded rapidly, creating a demand for small refrigeration compressors like the one illustrated.

In this cooling system provisions have been made to cope with all emergency conditions. These include piping for re-use and conservation of water. Moreover, should temperature of the water in the system rise above normal, fresh water is automatically introduced through a solenoid valve operated by a thermostat in the supply line.

Duplicate water circulating pumps insure continuous cool water supply to compressors since water-pressure failure in one automatically cuts in on the standby pump. To provide for the remote possibility of both pumps failing, an alarm system warns operator to turn on the emergency manually-controlled water supply.

Consultation with piping engineers is recommended when planning any major piping installations.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from Jenkins complete line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal.

COMPLETE DESCRIPTION AND ENLARGED DIAGRAM OF THIS LAYOUT FREE ON REQUEST. Includes additional detailed information. Ask for Piping Layout No. 61.

VALVE RECOMMENDATIONS
For details of valves to suit varying conditions, see Jenkins Catalog.

Code	Quan.	Jenkins Valves	Services
A	1	Fig. 47 Bronze Gate	Main Water Supply Shutoff
B	2	Fig. 352 Swing Check	Prevent Backflow
C	1	Fig. 47 Bronze Gate	Emergency Water Supply Shutoff
D	4	Fig. 47 Bronze Gate	Automatic Valve Shutoff
E	1	Fig. 106-A Bronze Globe	Manual Bypass of Automatic Valves
F	2	Fig. 368 Bronze Gate	Pump Suction Shutoff
G	2	Fig. 352 Br. Swing Checks	Prevent Backflow to Pumps
H	2	Fig. 368 Bronze Gate	Pump Discharge Control
J	3	Fig. 106-A Bronze Globe	Control Water to Condensors
K	3	Fig. 370 Bronze Gate	Condensor Discharge Shutoff
L	2	Fig. 743-G Bronze Needle	Pump Vent Control
M	2	Fig. 106-A Bronze Globe	Drain Valves
P	1	Fig. 743-G Bronze Needle	Pressure Gage Control
Q	1	Fig. 47 Bronze Gate	Make up Supply Line

Keep Informed

ANNOUNCEMENTS OBTAINED MOSTLY FROM ADVERTISERS IN MECHANICAL ENGINEERING AND ASME MECHANICAL CATALOG

New Equipment *Business Notes* *Latest Catalogs*

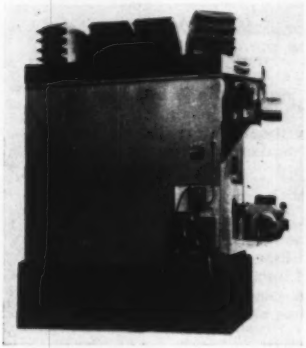
Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

New Equipment

Thermobloc

A new model Thermobloc—capable of producing 2 million Btu per hr output has been announced by the Thermobloc Div. of The Prat-Daniel Corp., South Norwalk, Conn. The new model—designed for large industrial applications—will heat an area of from 16,000 to 24,000 sq ft.

While the exterior has a smooth clean appearance with lines pleasing to the eye, the interior design is new and different. The Model 2000 has twin heat exchangers arranged in the form of a "V". This results in maximum scrubbing of the heating surfaces by the air passing through. For discharge, diffusers give pin-point control of air throw.



These outlets may be placed in any position desired. They can be rotated a full 360 deg. Single ducts may be run from any outlet to adjoining rooms if heat is needed in these places. The Model 2000 may also be used as a central heating plant. In that case, a plenum chamber is supplied in place of the four diffusers.

The new Model 2000 Thermobloc requires less floor space and less head room than most conventional space heaters. The normal air output is 22,000 cfm, and the air intake velocity is 440 fpm. The fan is powered by a 10-hp motor. The unit can use either light fuel oil, with a pressure atomizing gun-type burner; heavy oil, using a horizontal rotary cup burner; or gas, using a power burner. It may also be equipped with a combination burner for instantaneous conversion of gas to oil or oil to gas.

Automatic Program Controller

Builders-Providence, Inc., 345 Harris Ave., Providence, R. I., has announced the availability of the APC—Automatic Program Controller which is a simple and accurate device for controlling the feed of chlorine at predetermined rates for predetermined periods in identical cycles to meet variations in chlorine demand as they may occur. The controller consists of a simple cam-operated pressure valve so arranged as to transmit varying pressures to the lower diaphragm pressure chamber of the chlorine control valve in a chlorinizer. The cams are interchangeable with ease to meet the many variables encountered in chlorine demand and dosage.

Features of the controller are positive and accurate control, pneumatic or water operation, ease of installation, unlimited variety of programs, simplicity of operation, and long trouble-free service. All of the major elements in Builders-Providence program controller are self-contained in a dustproof case for panel, wall, or floor stand mounting.

High-Speed Copying Machine

Production of a new low-priced, high-speed Copyflex machine, the Model 30, for making copies in business and industry is announced by the Charles Bruning Co., Teterboro, N. J.

The Copyflex Model 30 was engineered especially to provide a machine that would be ideal for engineers, draftsmen, and business with moderate print requirements and a low budget for equipment outlays. It will speed production of engineering drawings, tracings, and other large-sized technical originals, while accounting departments and business offices will find it economical for copying large-sized records, balance sheets, charts, and cumulative statistical statements and reports kept by the day, week or month for production, inventory, sales and cost control.

The "30" has a full 46-in. printing width to handle standard 42-in. roll stock or insertion of multiple cut sheets of copying paper. Its 48-in., 2000-watt Vycor mercury arc lamp enables the machine to insure uniform exposure and to speed printing up to a maximum of 12 linear ft per min. The new design and utilization of controlled air flow assure a premium quality print that is ready for immediate use upon delivery by the machine.

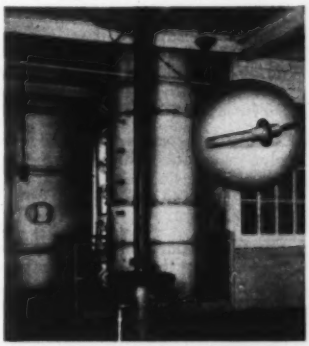
The Model 30 requires no installation, just a connection to a 230-volt 60-cycle a-c electric power line. Fifty-cycle machines are also available. It does not need any inks, negatives, masters, special lighting, dark rooms, plumbing, or exhausts to carry off fumes.

Copies may be made on Copyflex sensitized paper, acetate-coated paper, film, and cloth.

Fire Detector

The use of the Detect-A-Fire, a fire and overheat detector manufactured by Fenwal Inc., Ashland, Mass., has been instrumental in eliminating an explosion hazard in the distilling plants of Schenley Distillers, Inc. The hazard formerly developed when, during distilling operations, excessive pressure in a beer, whiskey, or alcohol still caused mechanical relief devices to operate, permitting alcohol vapors to escape into the still building.

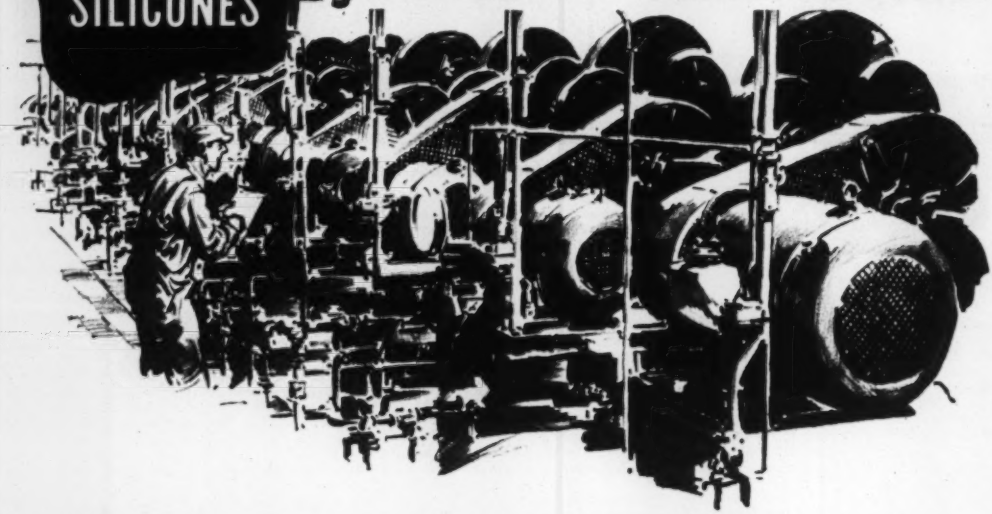
To eliminate this condition, a unique protective venting arrangement incorporating an alarm system based on the Fenwal detector was devised by Schenley engineers under the direction of Mr. G. M. Burke, Fire Protection Engineer. Seal pots (water-filled pressure-relief devices) were designed to include a 6-in. copper duct to carry the vapor directly from a "blown" pot to the exterior of the still buildings. This construction prevents the release of vapors inside the building, but raised the problem of finding a quick, positive means of detecting the escape of the alcohol to keep product loss to a minimum.



Detect-A-Fire units, which combine the properties of high sensitivity, rapid response, and explosionproof construction, were selected to trigger an alarm system. The detector reacts to the escaping hot vapor (about 220 F) and actuates both a visual and audible alarm that enables the still operator to take immediate corrective action. The duct from each seal pot contains a detector which operates a specific "drop tag" on a control panel. Actuation of a detector by escaping vapor closes a circuit which sounds a bell or siren, shorts out a green "safe-operation" light, while illuminating a red "trouble" lamp and operating the appropriate drop on the panel. If the blown seal is the result of a temporary vapor surge in the still, the operator merely refills the seal pot with water; otherwise, he shuts down the still until the trouble is located.

DOW CORNING
SILICONES

give motors more muscles



Gained 30% more pumping capacity; saved about $50,000

Engineers of a leading chemical company had to increase pumping capacity in one production unit by 30%. They did so by having 31 motors with name plate ratings of 50 and 60 hp at 850 rpm, rewound with Class H insulation to put out 75 to 90 hp at 1150 rpm.

New 75 hp motors with conventional insulation plus installation would have cost $68,200. Rewinding, plus installation on the original mounts, cost about $19,000. That's an initial saving of almost $50,000.

Equally important has been the added life and reliability of these Class H motors. The old 50 and 60 hp motors burned out at the rate of one a month or 48 failures in 4 years. Rewound with Class H insulation, these same motors have been delivering at least 50% more power for the past 4 years with only 6 failures.

That's why more and more engineers and management men specify Class H insulation for hard working motors, for critical motors that determine productive capacity, and for motors subjected to high ambient temperatures and excessive moisture or corrosive chemicals.

It has been proved over and over again that Class H insulation made with Dow Corning Silicones has 10 to 100 times the life expectancy of the next best class of insulating materials; can be used to increase the power per pound ratio in electric machines by as much as 50%.

mail this coupon today

Dow Corning Corp., Dept. Q-13, Midland, Mich.
Please send me:
- ☐ Catalog of Class H Insulating Materials.
- ☐ List of Class H motor repair shops.
- ☐ Data on Silicone Grease for motor bearings.
- ☐ 32-page booklet entitled "What's A Silicone?"

Name_____
Company_____
Street_____
City_____ Zone____ State_____

You can also reduce or eliminate motor outages due to bearing failure; specify Dow Corning 44 Silicone Grease for motor bearings.

In open and single shielded bearings designed for high temperature operation, Dow Corning 44 has 8 to 10 times the life expectancy of conventional greases. It gives life-time lubrication in permanently sealed bearings.

DOW CORNING SILICONES

DOW CORNING CORPORATION
Midland Michigan

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In Canada: Fiberglas Canada Ltd., Toronto • In England: Midland Silicones Ltd., London

Reproduction Chart

Faster solutions to a variety of drawing reproduction problems, as well as greater ease and convenience in making long-lasting, high-quality photographic reproductions, are expected to result from the use of a new Kodagraph materials selection chart announced by Eastman Kodak Co.

The chart, the company believes, will enable engineers, draftsmen, and others to use Kodagraph materials to the best advantage in reproducing originals in both good and poor condition on existing print-making equipment. Furthermore, it is expected that it will help assure that the reproductions obtained have exactly the characteristics desired.

The chart lists all commonly encountered types of originals and then—depending on the print-making equipment to be used—indicates the Kodagraph material or materials that will successfully reproduce each type. It also provides a general description of each of the materials listed and gives complete processing information.

Copies of the chart may be obtained without charge from Kodak industrial dealers or on request from the Industrial Sales Division, Eastman Kodak Company, Rochester 4, N. Y.

Aluminum Paste

Greater two-tone, flash, and glamour for polychrome or metallic finishes are possible through the use of a new aluminum paste made by Aluminum Company of America, Pittsburgh, Pa. Designated as Aluminum Tinting Paste No. 222, it gives a brighter finish than has been possible thus far with other aluminum pigments. It does not interfere with true color values, and gives a "clean" appearance of great depth to the finish. This pigment, while achieving the utmost in iridescence, is characterized by an absence of seeding.

While primarily intended for automotive finishes, the Alcoa paste also imparts a striking, beautiful effect to the hammer-tone finish on household equipment and appliances. Very pleasing effects can be obtained when used in nonsmudge solid aluminum colors. Here again its bright sparkling particles give that "new" look.

The metal content of the paste is 65%, the specific gravity is 1.47, weight per solid gallon is 12.245, and it has a bulking value of 0.0820 gal per lb.

Pipe-Testing Machines

In the last few years, Hydropress, Inc., New York, N. Y., has built and put into operation a number of hydrostatic pipe-testing installations. These machines are designed for the high-speed testing of pipes in accordance with the most recent API standards. These standards require test pressures up to 10,000 psi when testing N-80 grade pipe.

The machines can test, externally upset, plain-ended as well as coupled and threaded pipe. The high production rate of these machines enables them to be set directly into the production line of the finishing end of the mill, thus increasing the efficiency of mill operation. The testing equipment is controlled by one man from a central control pulpit.

These testers are designed to specifically meet all the API requirements for testing pipes as well as the individual working conditions in the mills where the equipment is installed.

To date, such units have been installed and are in operation at the Electric Weld Tube Mills of the Republic Steel Corp., Youngstown, Ohio; the Lorain Ohio Works of the National Tube Co.; the Fontana Works of the Kaiser Steel Corp.; the National Works of the National Tube Co.; and the Ambridge Works-Spang-Chalfant Division of National Supply Co. The testers installed at the two latter manufacturing plants are capable of testing pipe to 10,000 psi.

In addition to the foregoing installations, two machines are at present being erected at the Campbell Works of the Youngstown Sheet & Tube Co. in Youngstown, Ohio; two more are being built for the new seamless tube mill at the South Chicago Works of the Republic Steel Corp. These four machines are all capable of testing pipes to 10,000 psi.

Furthermore, four pipe testers are also being built for the new Electric Weld Pipe Mill of the Lone Star Steel Corp. in Dallas, Texas.

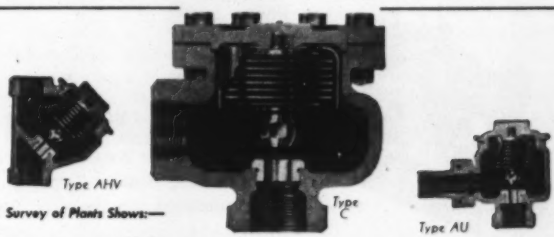
Hydropress has been active also in the field of pipe expanders, one installation of which was built for the Page-Hersey Tubes, Ltd., in Canada, and another one for the Briar Hill Works of the Youngstown Sheet and Tube Co. The latter installation represents the most modern and universal type of equipment in this field.

Pipe testers built in the past to special requirements are in operation at the Wheeling Steel Corp., Benwood, W. Va.; at Armco International Corp. in South America; and in other countries abroad.

Automatic Ice Maker

An automatic ice maker, the smallest commercial type ever developed, has been placed in production by York Corp., York, Pa.

This machine, to be known at the York-Flak Ice automatic ice maker, Model DER-2, is designed to produce up to 300 lb of ice in small clear fragments per day without the use of an auxiliary crusher.

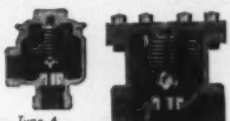


Survey of Plants Shows:—

15 of 20 Engineers Prefer Nicholson Traps

To determine the best steam trap on which to standardize, a large processing firm recently asked their plant engineers for their preference. In 15 out of 20 plants the choice was Nicholson. The repeated adoption of Nicholson steam traps in plants currently in big "cost-reduction-through-modernization" programs is another indication of their advanced features.

5 TYPES for every power, heat, process use. Sizes, ¼" to 2"; pressures to 250 lbs. To see why an increasing number of leading plants are standardizing on Nicholson thermstatic steam traps send for BULLETIN 152.



219 Oregon St., Wilkes-Barre, Pa.

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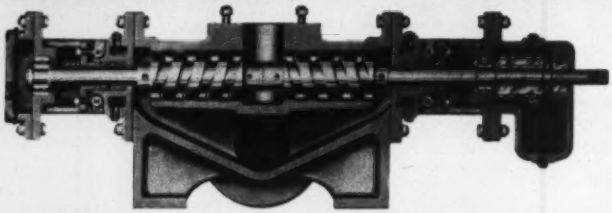
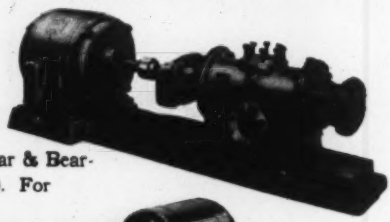
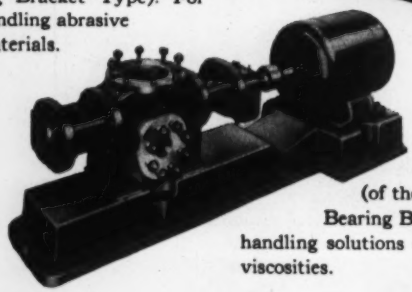


NEW EXTERNAL GEAR & BEARING BRACKET TYPE For handling non-lubricating fluids, semi-fluids. Capacities 1-700 GPM; Discharge 1000 PSI for viscous liquids, 500 PSI for water



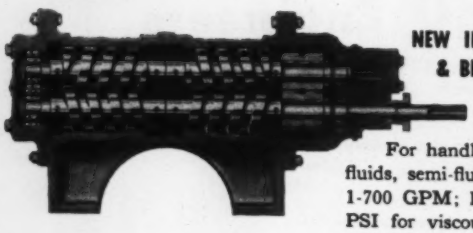
NEW LINER TYPE

(of the External Gear & Bearing Bracket Type). For handling abrasive materials.



NEW HOPPER TYPE

(of the External Gear & Bearing Bracket Type). For handling solutions of extremely high viscosities.



NEW INTERNAL GEAR & BEARING TYPE

For handling lubricating fluids, semi-fluids. Capacities 1-700 GPM; Discharge 1000 PSI for viscous liquids, 500 PSI for light oils.

WRITE FOR NEW *"Screw Pump Reply Sheet"*

Read the front side for features and advantages—then, if you wish, fill out the reverse side for a prompt, individually-engineered recommendation!

***Sier-Bath* GEAR and PUMP CO., Inc.**

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BUSINESS NOTES
LATEST CATALOGS

It was pointed out that this new machine was designed primarily to meet the increasing demands for equipment to produce ice in small pieces at the point of use by the smaller commercial establishments including bars, hospitals, soda fountains, hotels, restaurants, taverns, green groceries, chain stores, seafood houses, poultry stores, and other handlers of foodstuffs, including the military, where the daily ice requirements usually do not exceed 250 to 300 lb.

The product of the York-FlakIce automatic ice maker, it was explained, is in a slightly curved form. Because of the greater exposed surface area, it provides faster cooling of liquids. These small fragments of ice are claimed to be so delicate that they won't bruise or puncture fish, poultry, or even roses, when used in bulk, such as in a shipping carton or crate. Meltage also is retarded because of the shingling action of the curved pieces of ice.

The unit is air cooled and can be plugged into an electrical socket. It has a capacity range of from 200 to 300 lb daily, although the unit itself is only 32½ in. high and its widest diameter is only 24¼ in.

6-In. Dial Indicator

A newly designed dial indicator which is ideally suited for modern instrument panels and equally desirable for individual mounting, has been released by the Taylor Instrument Companies, 95 Ames St., Rochester, N. Y. This new instrument was primarily developed to meet the requirements of the many temperature, pressure, and load applications in industrial processing.

The Taylor 6-in. dia lindicator has a high-visibility dial with white graduations and numerals on a black background. Its white wedge-shaped pointer or indicator is provided with a microadjustment to permit easy and accurate zero settings. A notable feature is the new stainless-steel movement which is designed to eliminate linkage errors.

The design of the instrument provides for almost universal actuation by any variable that makes use of a Bourdon spring as an energy-to-motion converter. For temperature applications, four different types of actuation are available: mercury, vapor, gas, or organic liquid (Monolex). Ranges from −100 to +1200 F. For pressure applications, range spans from 12 to 20,000 psi are available. Tension and compression load elements can also be incorporated in the new instrument for load applications with ranges from 0 to 75,000 lb.

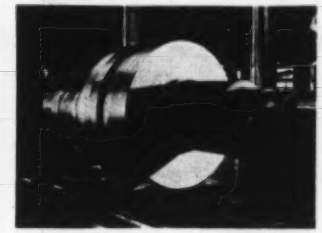
Write for Bulletin 98214, Taylor Instrument Companies, Rochester 1, N. Y.

Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Record-Size Spindle Forging

This 78½-ton low-pressure turbine spindle forging for a 120,000-kw cross-compound reheat steam turbine being rough machined on a lathe at Allis-Chalmers West Allis Works is probably the largest in diameter and weight ever used for a steam turbine.



The forging is 26 ft 5 in. long and 85½ in. maximum diameter at the center section. The original ingot weight was 185 tons. Three forged rings at each side of the spindle's center will carry outer blade rows. Flow of steam will be from the center to both ends through two identical eight-stage blade paths. Diameter of exhaust rows with 40-in-long blades will be 13 ft 5 in.

Magnetic Brake

A completely new magnetic brake design that eliminates all levers and linkage found in conventional units, has been developed by the Reuland Electric Co., Alhambra, Calif. This new brake contains only 6 major operating parts and features a direct, automatic set and release action between the solenoid and armature.

In addition to this new operational feature, the Reuland solenoid is of a one-piece "doughnut" design that permits the motor's output shaft to extend completely through the brake. This feature permits the user to utilize both ends of the motor shaft for powering two pieces of equipment when desired. Ordinarily, one of the motor's output shafts would have to be dead-ended at the brake.

Reuland magnetic brakes are also ideally suited to fluid-coupled motors and gear reducers because of this feature. The brake is installed on the output shaft of the fluid coupling with the shaft extending through the brake for hook-up to the load. Other features of this new magnetic brake are as follows:

Both weight and over-all length of the brake are approximately one-half that of all other makes.

Lining wear is automatically compensated for by spring tension. Brake torque remains the same and the usual inspection and hand adjustment procedure is thereby eliminated.

The direct action between the solenoid and armature, instead of through levers and linkage, provides instant set and release.

Brake sets by spring action when current is cut off—releases magnetically when current is reapplied.

Permits rotating of motor's output shaft by hand, if desired. Brake automatically re-sets when current is applied.

Removal of four machine screws releases housing to expose all parts. The disk-type lining can be replaced quickly. The one-piece cast housing is dustproof and weather resisting.

for 50 to 1 reduction on

OZALID STREAMLINER

developer drives . . .

WINSMITH SPEED REDUCERS ®

A copy in less than 30 seconds! Printing speed up to 14 ft. per minute! That's what this Ozalid Streamliner turns out for thousands of engineering, purchasing, personnel and accounting departments across the nation.

Because reproduction of letters, reports, drawings and records usually "can't wait", every component of Ozalid copying machines must be constantly relied upon to do its bit without failure. The Winsmith single reduction, 50:1 ratio, right angle drive, worm gear type reducer is a good example.

Serving the blower, developer and pump drive, which is powered by a 1/3 hp motor, this small, compact Winsmith unit is designed for the long-lasting service which Ozalid requires of all its components. Moreover, its vibrationless operation is necessary to the smooth, quiet performance for which the Streamliner is so well known. "We are pleased with the little servicing that these units have demanded over countless hours of usage", says Ozalid's chief engineer.

The importance that Ozalid, Division of General Aniline and Film Corporation, places on the selection of a speed reducer is typical of most industries . . . the very reason so many have become Winsmith users. Within the 1/100 to 85 hp range, no other speed reducer is available in so complete a selection of standardized types, sizes and ratings. *Catalog 148 will convince you.* Write!

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WITH A WEIGHTY PROBLEM
IRVING ALUMINUM GRATING
Irving Aluminum Grating is the solution where Strength and very Light Weight are wanted. Spark Proof. Rust Proof.
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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Reuland magnetic brakes are available in 3, 10, and 25 ft-lb continuous duty ratings—15 and 35 ft-lb intermittent duty types. They can be mounted on standard Reuland motors or on other motors by means of regular Reuland mounting methods, or to NEMA "C" face type endbells.

Engineering folder No. MB-1000 is available from Rueland Electric Co., Alhambra, Calif.

Automatic Mine Hoist

The first high-speed, balanced, automatic mine hoist ever to be used in the nation's coal fields has been installed at Farmersville, Ill., in the new Crown Mine of the Freeman Coal Mining Corp.

The 1000-hp, d-c hoist, driven and controlled by General Electric apparatus, is designed to lift 800 tons of coal up a 491-ft vertical shaft every hour, equivalent to the delivery of eight tons of coal to the surface every 36 sec. It has a rated rope speed of 1357 fpm.

Constructed by the Vulcan Iron Works of Wilkes-Barre, Pa., the hoist will utilize two skips, each weighing some $7\frac{1}{2}$ tons and having a pay-load capacity of eight tons. The G-E amplidyne-controlled, adjustable-speed drive is made up of a 1000-hp, 500-rpm, d-c drive motor and a 750-kw MG set consisting of a 4160-volt synchronous motor and a 500-volt, d-c generator.

The hoist drive is only part of an order for General Electric equipment for the mine and its preparation plant. Included are complete drives for washing and screening, full metal-clad switchgear to feed power at 4160 volts throughout the project; six 300-kw, a-c portable rectifiers for underground power; three 1000-kva load center unit substations, and a fourth unit substation rated at $112\frac{1}{2}$ kva for lighting supply.

Flexible Shaft Unit Drives

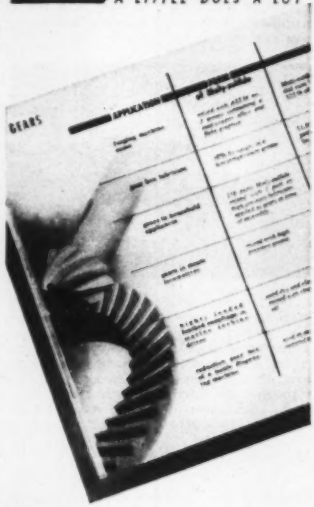
Elliott Mfg. Co., has come out with a complete new line of ready-to-use Econoflex flexible shaft unit drives, available for shipment from stock, in four size ranges—heavy duty, medium duty, light duty, and drill shaft unit.

The heavy-duty range provides 180 different standard units, varying in style of end fittings, bearings, lengths of shafting—in core diameters from $\frac{1}{2}$ to $1\frac{1}{4}$ in. The heavy-duty drives are for applications requiring high strength, moderate flexibility, and lower operating speeds, as for power take-offs. They are specified by designers for connecting two rotary shafts which are not in line, or where one shaft moves relatively to the other, or where frequent disconnection is required.

Econoflex medium-duty drives are available in 6 core sizes, from $\frac{3}{16}$ to $\frac{5}{8}$ in. in diam. They may be attached to any power source—electric motor, gasoline engine, drill press spindle, or countershaft—and may be used to perform all the operations which are possible with a complete flexible shaft machine, such as grinding, buffing, wire brushing, drilling etc.

The Econoflex light-duty unit drive has a $\frac{3}{8}$-in-diam core; the drill Shaft, $\frac{1}{4}$-in-diam core.

Complete specifications, accessories, etc., are shown in Catalog No. 210 (Spanish edition, No. 210-SP) available on request to: Elliott Mfg. Co., 352 Prospect Ave., Binghamton, N. Y.

Effective even where other lubricants have failed
Moly-sulfide
A LITTLE DOES A LOT


Moly-sulfide, a solid film lubricant, stands out most where the lubricating conditions are the most difficult. If you have to contend with extreme conditions of pressure, temperature, fretting, or velocity, you should try Moly-sulfide. First write for a copy of this free 40-page booklet which shows where the above conditions have already been overcome in the shop and in the field.
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MOLY
MS. 7

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Sealed Ball Bearings

Sealed ball bearings, exclusively designed to keep dirt out and lubricant in and that are interchangeable with conventional non-sealed bearings, have been announced by SKF Industries, Inc., Philadelphia, Pa. Known as SKF's Red Seal bearings, the seal is made of stable DuPont Fairprene, and is not affected by petroleum-base lubricants, normal operating temperatures, or ageing.

An exclusive design, providing effective sealing—with extremely light contact and low friction—extends the seal below the steel retaining ring, forming a flexible lip which lightly touches a smooth uniform chamfer of the inner ring.

Retaining rings have circular-formed ribs giving them great rigidity, and are staked securely during manufacture. The bearings are delivered factory-lubricated.

SKF Red Seal ball bearings were proved in service by manufacturers of electric motors, portable tools, household appliances, and other machinery where sealed bearings permit simplicity of design and are effective in keeping dirt out and lubricant in. They are supplied in standard single-row SAE widths, and are available with any combination of snap rings and metal shields.

Button-Head Socket Screw

A button-head, socket screw, designed for use where streamlined appearance and high strength are wanted, has been put on the market by Standard Pressed Steel Co., Box 558, Jenkintown, Pa.

The new screw, latest addition to the SPS Unbrako line, has a low head with a hexagon socket. Made of alloy steel and heat-treated, it can be used without loss of strength in place of screws with higher heads, many of which have sharp, dangerous corners. Hence the low button-head promotes safety and ease of cleaning.

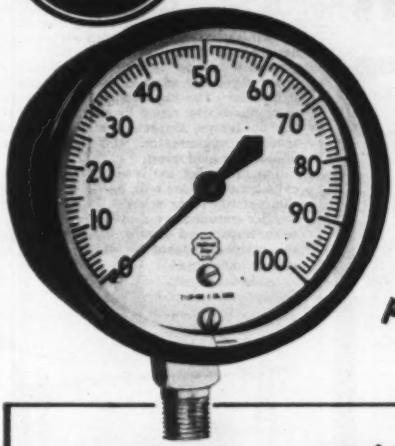
SPS said the button-head had many applications, particularly where countersinking was impractical.

The button-head screw is made in seven thread diameters: No. 8 (0.164 in.), No. 10 (0.190 in.), and 1/4, 5/16, 3/8, 1/2, and 5/8 in. All except the 1/2 and 5/8, which are produced in the National Coarse series only, are available in both National Coarse and National Fine threads. The different diameters, all threaded to the head, come in four to seven lengths. Threads are precision-rolled.

For Consulting Engineers Turn to Page 120

an ACCO product

HELICOID



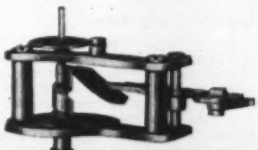
The gage that retains its original accuracy longer, lasts longer, costs less per gage, per year

NOW...a 3½" Gage

Now you can get the popular gearless Helicoid Movement in a 3½" Helicoid Gage for pressures from 100 lbs. to 10,000 lbs. and vacuum, in steel systems, or 15 lbs. to 1000 lbs. and vacuum, in bronze systems. Phenol or ACALOY case. Prominent black letters on white phenol dial. Stem, panel or flush mounting.

The Helicoid Movement is a simple cam and roller design that has no teeth to wear out. Tested and proved in years of hard service. Helicoid Gages give long, trouble-free service with little maintenance.

Only Helicoid Gages have the gearless Helicoid Movement, so look for the name Helicoid.



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for the Helicoid Catalog

FOUR HELICOID FEATURES

1. Stainless Steel Helicoid Roller (no gear teeth)
2. Stainless Steel Hair Spring
3. Long Life Cam (no gear teeth)
4. Corrosion Resistant Link and Screws

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AMERICAN CHAIN & CABLE

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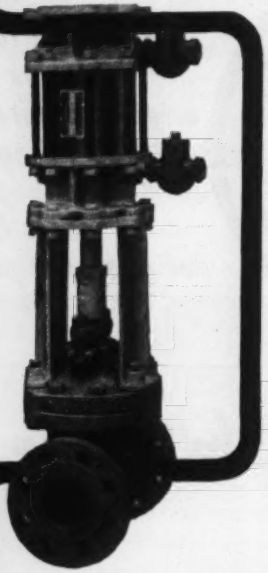

for POWER OPERATION and REMOTE CONTROL of Line Valves

If you require automatic controls or power operation—or if your plant uses many valves in remote or inaccessible spots, you can save manpower and simplify your operations by installing Ledeen Valves. Adaptable to most any make, size and type of valve to operate against any line pressure, for any fluid medium, with any pressure. Positive, rugged, economical.

Write for Bulletin 512

VALVES • CYLINDERS
AIR-HYDRAULIC PUMPS & BOOSTERS
VALVE ACTUATORS • AIR HOISTS

Ledeen Mfg. Co.
1600 San Pedro
Los Angeles 15, Calif.

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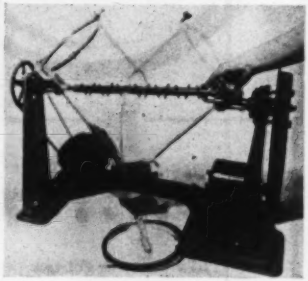
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Twin-Shell Blender

The Patterson-Kelley Co., Inc., 490 Warren St., East Stroudsburg, Pa., now offers its twin-shell blenders equipped with a newly designed rotating "intensifier bar." The twin-shell blender is a recently developed mixer especially adapted to the processing industries. The lug-studded intensifier bar improves mixing action by effectively breaking up lumps, dispersing materials which tend to agglomerate, and homogenizing liquids into solid mixes.

The intensifier bar is so located that the cylindrical lugs act only on the top layer of the material being mixed. Rotation of the blender continuously supplies fresh material to the impact and shearing action of the lugs, the peripheral speed of which is approximately 2500 fpm.



The metal bar is belt-driven by a separate motor. Power requirements are small since the bar acts only on the top layer of material. The bar is easily removed for cleaning by pushing it toward the spring-loaded end and sliding it from its sockets. It is currently available on all units up to the 60-cu ft size.

The twin-shell blenders themselves are available both in acrylic plastic and steel types. Their design and construction provides a new and efficient mixing principle which involves a combined tumbling or rolling action with a simultaneous transverse movement within the entire mass of material. In addition, a folding action is caused by the combining and dividing of the mass as the blender rotates.

Industrial pH Meter

A new type pH Meter, especially designed and ruggedly built for plant use, has been developed by Cambridge Instrument Co., Inc., Grand Central Terminal, New York, N. Y. With it, pH determinations can be quickly and accurately made—whether the pH of sample test solutions or the pH of the contents of vats and tanks at various stages in a production process.

Compact and portable, the Cambridge industrial model pH Meter is all-electric; plug it into the nearest 110-volt a-c outlet and it is ready for operation. So simple that unskilled workers can easily use it. Stability is high, insuring accurate results with minimum adjustment.

The Cambridge line-operated, direct-reading pH meter will find many applications in process industries such as plating, chemical, textile, food, etc., which have hitherto lacked a satisfactory means of making pH measurements directly on plant operations.

MERCOID

The Choice of Experienced Engineers

IT'S THE MERCURY SWITCH THAT DISTINGUISHES MERCOID FROM THE AVERAGE LINE OF CONTROLS

1ST IN ··· QUALITY
ACCURACY
DURABILITY
PERFORMANCE
DEPENDABILITY
SAFETY FEATURES
EASY INSTALLATION
QUICK ADJUSTMENTS
SIMPLIFIED WIRING
UNFAILING SERVICE

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- **"INDEX TO PROFITS"** . . . Follow the assembly of an intricate 34-piece automobile door latch through a highly compact, production line that saves space and cuts lost motion to the minimum. (20 minutes running time.)
- **WRITE DENISON** or contact the Denison representative in your area giving your film choice and showing date.

The Denison Engineering Company
1189-A Dublin Road Columbus 16, Ohio

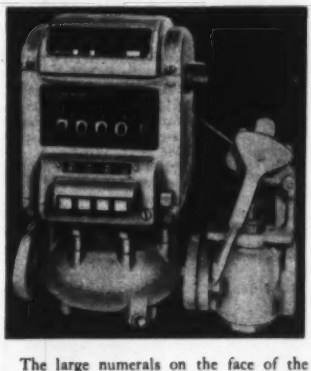
DENISON HydrOILics

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Auto-Stop Meter

A new Auto-Stop meter that accurately and automatically controls the quantity of industrial liquids fed into processes or batching operations has just been released for application on more than 100 industrial liquids by Neptune Meter Co., 50 W. 50 St., New York 20, N. Y. It consists of a Neptune Model 432 Auto-Stop register mounted on a Neptune Type S disk meter. The register is coupled to a quick-closing valve. The meter automatically shuts off the valve when it has delivered the number of gallons or pounds for which it has been set. In this way it saves ingredients, controls formulas, keeps product quality uniform, and eliminates spoiled batches. By keeping liquids inside the pipe right up to the blending tank, it eliminates handling, improves housekeeping and helps to prevent unsafe conditions.

Operation is simple. The tripping mechanism is first set by pushing the buttons on the register until the number of gallons desired shows up on the numeral wheels just above the buttons. The register is then cleared back to zero by turning the reset handle at right, the valve is opened, and the operator is free to devote his attention to other jobs. The Auto-Stop tripping device automatically cuts off the flow when the set quantity is delivered.



The large numerals on the face of the meter keep pace with the flow, and provide a visual check when the delivery is finished. The small shuttered totalizer also on the face of the register keeps cumulative totals, from which daily, weekly, or monthly production or inventory figures can be recorded.

Complete details including a list of the liquids these meters can safely handle, are given in new Neptune Bulletin 566-7.

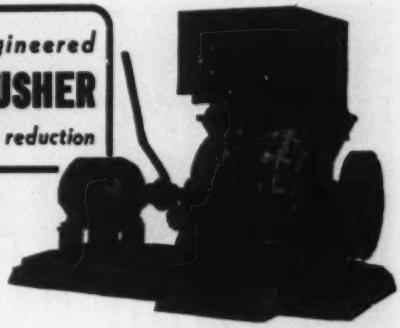
Sound-Survey Meter

Smaller, lighter in weight, easier to use, and much lower in cost than standard sound-level meters, a new GR Type 1555-A Sound-Survey Meter, announced by General Radio Co., 275 Massachusetts Ave., Cambridge, Mass., has a wide range of applications in nearly all fields of sound measurement.

Among the industrial uses of the instrument are the measurement of machinery noise, deafness-risk surveys, and noise studies on industrial equipment and household appliances. Audio engineers will find the Sound-Survey Meter useful for adjusting relative level of speakers, checking the

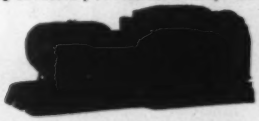
There's a job-engineered
AMERICAN CRUSHER
for uniform . . . low-cost reduction

. . of COAL, CLAYS, CHEMICALS, STONE, METAL TURNINGS, WOOD, DRY ICE, FOOD—hundreds of products of every description.



Metal Turnings Crusher—reduces long, curly turnings of steel, alloys, brass, aluminum, etc., to uniform chips for highest cutting oil recovery . . . increased scrap value.

Laboratory Mill—for testing, pilot plant operation and waste reduction.



"AC" *Ring Mill*—with exclusive shredder rings—for uniform, high tonnage reduction. 500 TPH. "24 Series" ring or hammer crushers offer capacities to 50 TPH. . . . "30 Series" Hammermills to 100 TPH.

Write for complete information on the famous American line of crushers.

American PULVERIZER COMPANY
Originators and Manufacturers of Ring Crushers and Pulverizers
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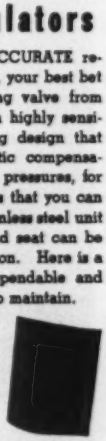
Control reduced pressures
more accurately!

KECKLEY
Pressure Regulators

- "Unit Pilot Valve" easily removable — and renewable.
- Stainless Steel parts for lower maintenance, longer wear.
- Sizes from ½" to 6" — Screwed or flanged.
- Initial pressures to 300 lbs. steam, 600 lbs. air. Reduced pressures to a low of 1 lb.
- Varied pressure control obtained without change of springs.
- Available in various combinations for pressure control, temperature control, single unit pressure and temperature regulation as well as constant pressure pump governors.
- Completely interchangeable parts for comparable sizes.

Where you have to maintain ACCURATE reduced pressures for air or steam, your best bet is a precision pressure regulating valve from Keckley. These valves feature a highly sensitive diaphragm and spring design that gives dependable automatic compensation for fluctuating initial pressures, for constant reduced pressures that you can depend on. Standard stainless steel unit pilot valve, main valve and seat can be removed easily for inspection. Here is a valve that is rugged, dependable and unbelievably economical to maintain.

Standardize on Keckley for the best in pressure regulators.



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dynamic range, and frequency response. College and high-school physics laboratories can use this low-cost meter for demonstrating sound phenomena. Speech and drama classes in work with both deaf and normal persons will also find many uses. Architects and field engineers will find it convenient to use the Sound-Survey Meter because of its pocket size and light weight (1 lb 14 oz with batteries).

Although shaped to fit the hand, the meter can be set on a table or mounted on a tripod. Only two controls are used and both are mounted conveniently on the front together with the large easily read meter. The instrument can be carried in a pocket but a leather carrying case, with room for spare batteries, is available as an accessory.

The total sound-pressure-level range of the meter is from 40 to 136 decibels and three frequency weighting networks are provided. Although low cost and small size were design objectives, high-quality components have been used throughout.

Stainless Steels

A new group of stainless steels has been introduced commercially to help circumvent the critical nickel shortage, according to Allegheny Ludlum Steel Corp., Pittsburgh, Pa. The new alloys, which use manganese to replace all or most of the nickel used in conventional chromium-nickel stainless steels, represented most of the product achievements of the company during 1951.

Chromium-manganese alloys, some containing no nickel and some with only minor additions of that element, have been introduced as suitable alternates for specific applications previously filled by the 18-8 stainless steels. These chromium-manganese steels, the company indicated, have been known for many years but it was not until 1951 that processing and fabricating techniques were developed which permitted their production in substantial quantities by the company.

Other new steels produced by Allegheny Ludlum during 1951 include high-temperature alloys for the military jet program and a new high-manganese alloy for automotive exhaust valves. In virtually all instances, according to the company, the new alloys were developed as a means of overcoming shortages of alloying materials which harassed company production throughout the year.

Keep Informed

NEW EQUIPMENT
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Vacuum-Service Valves

Rockwell Mfg. Co., Pittsburgh, Pa., has announced that extensive research tests have shown that its Nordstrom valves can be successfully used on the vacuum services in the production of titanium. This metal, so important because of its lightweight, unusual strength, and corrosion-resistant qualities, is being widely used in jet airplane-engine production.

A large Eastern chemical company experimenting in the production of titanium discovered that in melting sponge titanium, which resembles gray coke, alteration of certain titanium properties took place because of the metal's affinity for gases. Even air drastically changes titanium properties. All work, therefore, is performed under vacuum at a pressure of less than 10 microns.

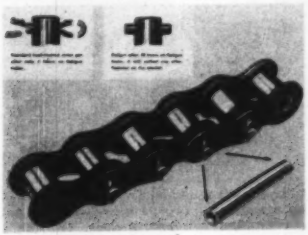
Further complicating the problem was the presence of "sludge." The problem was licked by applying lubricated-type Nordstrom standard semisteel plug valves to the vacuum services.

Rollpins

Use of Rollpins, new roller chain fasteners outlasting cotter pins ten to one, has been announced by Morse Chain Co., Division of Borg-Warner Industries, 7601 Central Ave., Detroit, Mich.

The Rollpins will be available on most of the larger pitches of both standard and heavy-series Morse roller chains.

The Rollpin is a chamfered-end, slotted steel cylinder that compresses easily into a pin hole smaller than its own diameter, expands, and locks in place until deliberately removed by hammer and punch. It may be re-used almost indefinitely.

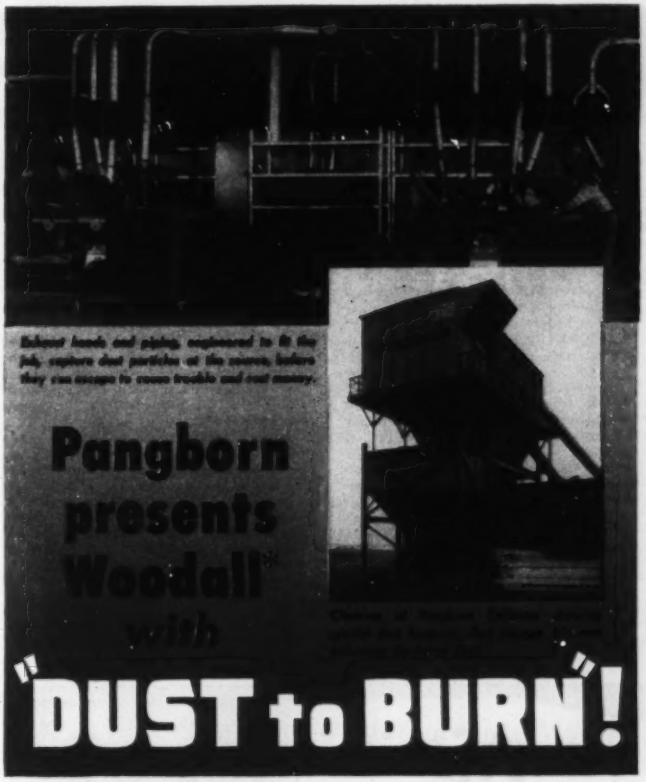


According to Morse officials, the Rollpin is the most durable fastener ever developed for roller chain. Besides providing fastener life vastly exceeding that of cotter pins, the Rollpin is equal in shear strength to cold-rolled pins of the same diameter. It can't fatigue out even under the most severe working conditions.

Demineralized Boiler Feedwater

Economy of operation is today's by-word of American industrial enterprise. Power manufactured as a by-product of process steam offers the lowest cost in fuel per kwh obtainable from any type of power plant.

When a public utility installs high-pressure turbines to exhaust its steam and then sells this exhaust to private industry, it is generally good economy and practice to install as high boiler pressures as are practical. On the other hand, it is the industrial plant such as an oil refinery or chemical manufacturer that endeavors to select a boiler pressure so as to



***How Woodall Industries, Inc., uses Pangborn equipment to save $14,000 per year!**

Woodall Industries, Inc., Long Island, N. Y., produces Masonite panels in varying shapes and sizes for the automotive, railroad, television, and refrigeration industries, to name just a few. Shaping and drilling these panels produces Masonite dust—and plenty of it!

Without an effective system of dust control, Woodall workers would soon be knee-deep in dust. Thus, the Pangborn Dust Control System installed at Woodall would be essential at any cost. The beauty of the system, however, is that it *doesn't cost at all*—but actually pays its own way, with a nice profit to boot!

That's because this Pangborn Dust Control System not only maintains a dust-free plant, but also provides *all* the fuel for all heating and processing requirements, by conveying the Masonite dust from its source to a boiler furnace. Savings in oil alone have been figured at about $14,000 a year!

Add to this the savings in "housekeeping" costs, benefits in improved health and morale of employees—and you can see why Woodall is so enthusiastic about their Pangborn Dust Control System.

What are your Dust Problems? Find out what Pangborn can do to solve them. Write today for Bulletin 909A. Address: PANGBORN CORPORATION, 2200 Pangborn Blvd., Hagerstown, Md.

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment

Pangborn DUST CONTROL

STOPS THE DUST HOG from stealing profits

produce substantially all of its power requirements from the amount of steam used for process. If the manufacturing industry can produce as much power as it could consume in its own plant at 900 psi when supplying necessary process steam, there would be no economy to go to 1200 or 1500 psi.

Therefore, in the case of a public utility, the higher the boiler pressure, the more by-product power they can produce and consequently sell for profit. Generally, its power is produced in surface condensing plants where much of the heat is lost in the cooling water of surface condensers.

Utilization of exhaust steam directly to process makes possible the avoidance of any heat loss in condensing water. This is accomplished by using high-pressure turbines exhausting directly to the process headers.

This is the principal behind the installation of the largest water demineralization and silica absorbing plant for the treatment of boiler feed make-up at Gulf States Utilities, Baton Rouge, La. The equipment is being supplied by The Permutit Co., New York, N. Y.

In general, utilities like Gulf States, are very conscious of their "bread and butter," their steam and power generation facilities. When inoperative, they provide no revenue and tend to create poor customer relations. In all instances, they "mother" this expensive apparatus and protect it from the ravages of corrosion and scale so as to eliminate costly shutdowns and repairs.

Of prime importance in protecting this equipment, is the plant's water supply. This must be entirely adequate for all contingencies and absolutely free from corrosive minerals.

Keeping purity of water in mind, in 1929 Gulf States designed a plant to produce power with high-pressure turbines, thereby pioneering in the sale of exhaust steam to industry at desired pressures. Due to the large make-up requirements, the incoming raw water supply was softened with Permutit zeolites for the protection of the boilers operating at 640 psi.

Boiler feedwater equipment for their original power station consisted of presettling tanks, intermittent coagulating tanks, gravity filters, and five horizontal Zeo-Dur softeners with acid and phosphate feeding equipment. Capacity of the plant was 2000 gpm. Later, two additional softeners were installed and subsequently the capacity was further increased by the installation of double-decked Spaulding Precipitators and replacement of Zeo-Dur with Zeo-Karb.

Being eminently successful with this original venture and with new industry moving within the territory served by the utility, they decided to make additional steam available at higher pressures and also produce lower-cost electrical energy to take care of increased customer demands.

Now in the construction stage, under the direction of Stone & Webster, Consulting Engineers of Boston, Mass., are these new facilities. For this expansion, they will erect 1800 psi boilers and install a push-button automatic 3500-gpm Permutit demineralizing plant. This equipment completely demineralizes the raw water so necessary for the higher quality make-up supply required by the new boilers.

Equipment consists of 8 cation exchangers, 8 anion exchangers, and 2 high vacuum deaerators. These cation exchangers will be utilized to remove the carbonates of calcium, magnesium, and sodium from the water while the anion units will be used to remove the sulphuric and hydrochloric acids formed by the cation exchangers. The deaerators will receive water from the cation exchangers for the purpose of removing carbon dioxide and oxygen gases. The result is an effluent equivalent to distilled water.

This demineralizing apparatus has been designed for extreme flexibility. It is suitable for the clarification of well water on the property and Mississippi River water which is available for the public utility's use.

Search your plant for iron and steel scrap... help our country to get enough steel

It takes scrap . . . to make steel.

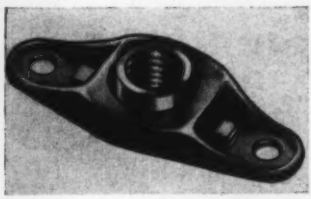
Multiply the amount of iron and steel scrap in your plant by 2 . . . that's the amount of steel that could be made if that scrap were salvaged.

Today, there's not enough scrap coming in from normal sources to keep steel mills and foundries producing at capacity.

NON-FERROUS SCRAP IS NEEDED TOO!

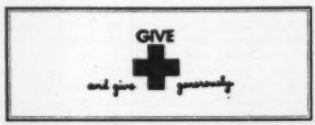
Floating Anchor Nut

A revolutionary Kaylock lightweight self-locking nut is now available in a floating anchor nut type, according to an announcement made by the Kaynar Co. of Los Angeles, Calif.



The new floating anchor nut consisting of an assembly of two parts—a threaded nut portion and a retaining shell—provides a $^{1}/_{16}$-in. radial movement between the nut and the anchoring portion. Both parts are formed of light gage annealed spring steel, and are spring tempered to provide an exceptionally lightweight, yet rigid and strong, fastening device. The "float" (a lateral movement between the nut and the anchored retaining shell) facilitates alignment of the nut and the bolt in subsequent assembly.

An exclusive and important feature of this new floating anchor nut is that in its plan view it is identical in outline and size to standard fixed anchor nuts of comparable thread size, thus permitting a complete interchangeability. In addition, it is low in weight.



Keep Informed

NEW EQUIPMENT
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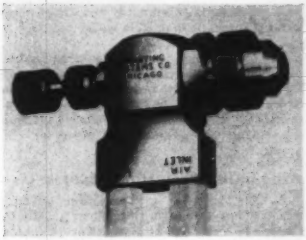
Pneumatic Atomizing Nozzle

A new pneumatic atomizing nozzle has been announced with both air and liquid inlets positioned at the top of the nozzle body, at right angles to the direction of spray. Identified as the Spraying Systems 1/8 JACN, this new pneumatic atomizing nozzle design solves many special mounting problems.



The unit is supplied with shutoff needle. The same design nozzle is also available without shutoff needle, identified as the 1/8 JAC. Capacities of these nozzles and the types of spray are determined by the fluid and air nozzle assemblies. A wide range of these assemblies or setups are available to provide pressure or siphon setups with round, wide angle round, and flat sprays. For complete information write to Spraying Systems Co., 3265 Randolph St., Bellwood, Ill. Ask for Data Sheet 4922.

Vinylite Resin Plastigels

A new, economical means of producing a wide variety of products made of Vinylite plastic is provided by a new formulation of Vinylite resins developed by Bakelite Co., New York, N. Y., known as plastigels.

Relatively light, simple equipment serves to produce intricately molded, embossed, extruded, calendered, coated, dip-coated, or stamped plastic products using this material of putty-like consistency. The resulting economies in both equipment and operating costs open many new fields of application in addition to permitting reduced production costs for many existing items made of versatile Vinylite plastic.

In their raw state, Vinylite resin plastigels are relatively stiff. They can be quickly softened at room temperature by stirring or kneading, and formed by hand pressure, molds, or dies into complicated shapes and fine details. After forming, plastigels gradually stiffen again, becoming self-supporting. They bake to a hard, finished state in about 10 to 15 min at only 350 F, without sagging, shrinking, or otherwise losing their formed shapes.

Varying amount of coloring agents, fillers, and volatile diluents mixed with the pastigels provide the proper viscosity for different fabricating operations and the desired color and stiffness in the completed product.

After curing, products made of plastigels have the same characteristics they would have if made from Vinylite resins by conventional fabricating methods. These include exceptional durability, resistance to tearing, abrasion, scuffing, folding, moisture, mold, mildew, oils, greases, foods, and many chemicals.

Vinylite resin plastigels are particularly suited for producing floor tile, tubing, intri-

SPECIALLY DESIGNED
for
EASIER INSTALLATION
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LONGER SERVICE

Fig. 0611, IBBM Wedge Gate Valve, Working Pressures: 125 lbs. Steam, 200 lbs. WOG.

KENNEDY JOB-FITTED
Iron-Body Wedge Gate Valves

YOU SAVE TIME AND MONEY all along the line with Kennedy iron-body wedge gate valves because they are JOB-FITTED . . . every valve specially designed and engineered for the job it has to do.

THE WEDGE DISC is a cored casting of thick metal section, reinforced by integrally-cast interior posts and provided with openings to drain in any position.

HEAVY BRONZE DISC RINGS are forced into dovetailed grooves in the disc in a practically inseparable construction.

HIGHER STRENGTH IRON in the body and bonnet is actually 50% stronger than ordinary cast iron . . . and far exceeds A.S.T.M. requirements.

ALL CONTACT SURFACES between moving parts are bronze-to-bronze to assure easy operation.

RUSTPROOFED STEEL BOLTS AND NUTS have ample clearance to prevent distortion. Open-end wrenches may be used . . . no need for special tools. Valves can be repacked under full pressure.

EVERY FEATURE of the valve helps it do the job better . . . gives you a solid guarantee of economy and dependability whenever you install one of these Kennedy Job-Fitted Wedge Gate Valves.

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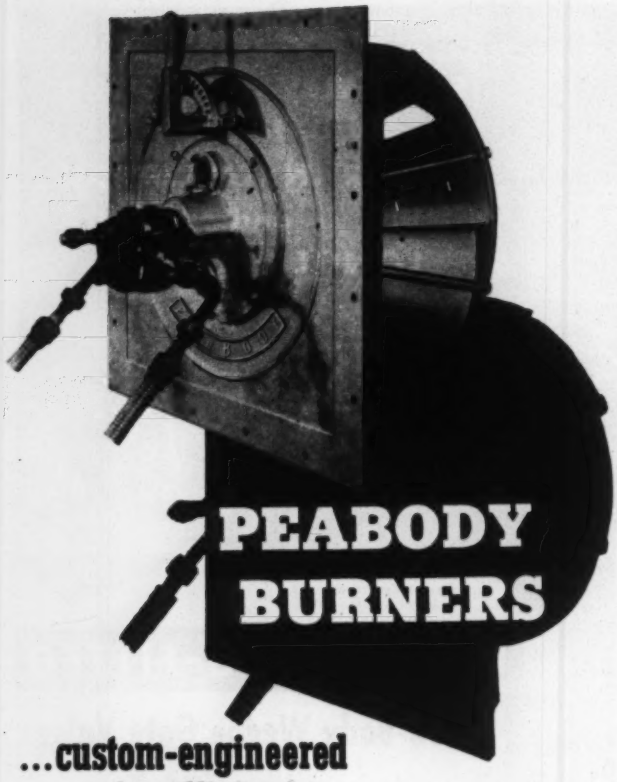

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cate electrical fittings, toys and novelties; for coating cloth, paper, and dip-coating wire objects. Models, flexible molds, tool handles, orthopedic and prosthetic appliances are a few of the objects which can be modeled from plastigels.

The low density and nonshattering qualities of plastigels suggest that they may replace ceramics for equipment to resist inorganic acids and alkalis at room temperature. Caulking compounds and tailor-made gaskets made of plastigels could be fused in place.

The low forming pressure required enables plastigels to be used as potting compounds for protecting coils and intricate electrical equipment without disturbing delicate connections; flexibility and low shrinkage during curing are also advantageous in this application.

Aluminum Production Plant

A 70% increase in aluminum smelting capacity has been made possible at Aluminum Company of America's Point Comfort (Texas) Works by an addition to its gas-fueled power generating facilities. Point Comfort, the world's largest internal-combustion-engine generating station, now has a total engine rating of approximately 350,000 hp.

The increase in available power will give Point Comfort an aluminum producing capacity of 85,000 tons annually.

The first aluminum was poured at the Point Comfort Works on Feb. 11, 1950. Point Comfort was the first new aluminum smelting plant built after World War II and the first in the growing Texas aluminum industry.

The original power plant included 120 engine-generator units, 40 of them housed in each of three buildings. To increase the power output, 74 new units have been installed in two additional buildings.

All 194 engines, built by Nordberg Mfg. Co., are of the two-cycle, radial type, incorporating an advanced design of dual-spark ignition. The engines have a 14-in. bore and a 16-in. stroke.

Although the 74 new engines are similar in general design and appearance to the 120 original ones, there are important differences between the two. The new engines have 12 cylinders instead of 11 and, since the cylinders are the same size, the new model develops about 9% more power.

In addition, a distinctly new type of stabilizing mechanism is employed in the new engine to permit the master crankpin bearing assembly to gyrate and yet to prevent it from rotating in response to the torque from the connecting rods. This was accomplished in the original 11-cylinder engine by means of a planetary gearing system.

In the new engines, however, a simple crank mechanism operating between two connecting rods and their knuckle pins is substituted for the gearing. The relatively small torque tending to rotate the master crankpin bearing assembly is absorbed by small reactions on two of the pistons.

Although the same impulse generator is used for ignition on both model engines, it is combined with the distributor as a single unit in the new model, instead of being driven separately.

Manipulator Valve

A new manipulator valve for 0 to 3000 psi service, has been announced by Barksdale Valves, 1566 East Slauson, Los Angeles 11, Calif.

To appreciate the operation of this valve it is important to understand the functioning of its unique Shear-Seal principle. The tubular sealing members are so designed that they maintain a balance between the line pressure and the sealing force. Actuation of the valve takes place along the path of least resistance, by shearing the stream between two lapped members. This, in conjunction with generous ball bearings in the valve housing, accomplishes extremely free handle movement for manipulating and inching cylinders and hydraulic motors.

Absolute shut-off to prevent creeping, is another requirement often asked of Manipulator Valves, and the Shear-Seal principle meets this demand because the lapping action of the sealing members actually improves the sealing qualities in service.

The valves come in normally open and normally closed flow patterns from 1/4 to 1-in. pipe size, and for manifold mounting.

Double-Suction Pumps

Ingersoll-Rand announces further advanced design improvements in its existing line of small, single-stage, double-suction pumps. These pumps, known as the Class DMV-DHV, are the first to incorporate double mechanical shaft seals with sealed, prelubricated ball bearings. The result is a compact, totally enclosed pumping unit that requires minimum attention and maintenance and reduces floor space requirements. Built in 3, 4, 5, and 6-in. sizes, the DMV (for medium heads) and the DHV (for high heads) are designed for general hydraulic services at temperatures up to 200 F, capacities to 2100 gpm, and pressures to 150 psi.

The use of a double-shaft seal affords the advantages of more efficient sealing and prevents air leakage into the pump when it is operating under suction lift. The double seal also has a longer service life under conditions when the pump is handling gritty and abrasive liquids, since external sealing liquid is injected to the seal box under pressure—lubricating the seal faces and preventing the gritty fluid from reaching them.

The cartridge type, permanently lubricated ball bearings, successfully used in motors of nationally known make, are packed with lubricant by the manufacturer and require no further lubrication throughout their service life.

Standard materials—cast-iron casing, carbon-steel shaft, and bronze impeller—are used to equip the Class DMV-DHV pumps for any noncorrosive service. Information is available from Ingersoll-Rand Co., Dept. CAM, 11 Broadway, New York 4, N. Y.

WITH

HELI-COIL® INSERTS

These stainless steel wire inserts strengthen threads so greatly that stripping is eliminated, thereby allowing you to utilize the full tensile strength of each cap screw. You can: (A) *use smaller cap screws* – (B) *use fewer cap screws* – (C) *use shorter thread engagement* – (D) *use cap screws in place of studs or bolt-and-nut assemblies* – (E) *use lighter bosses and flanges.*

Inexpensive *Heli-Coil* wire inserts, easily wound into slightly oversize tapped holes, remain permanently in place, providing easy-running female threads that are immune to wear, galling and corrosion.

The result is an improved product – cleaner looking, lighter, easier to service—frequently at reduced manufacturing cost.

Case histories, pointing up these benefits, are presented in *Heli-Coil*, our engineering periodical which is yours for the asking. Use the handy coupon to put your name on the subscription list.

*Reg. U. S. Pat. Off.

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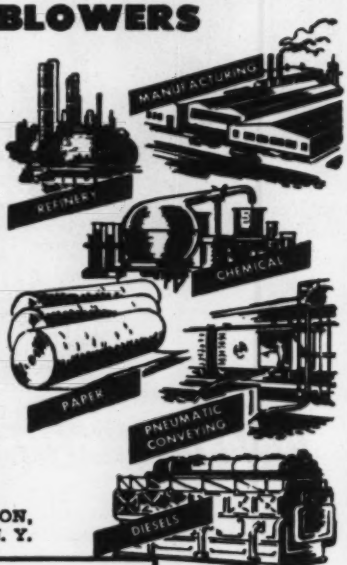

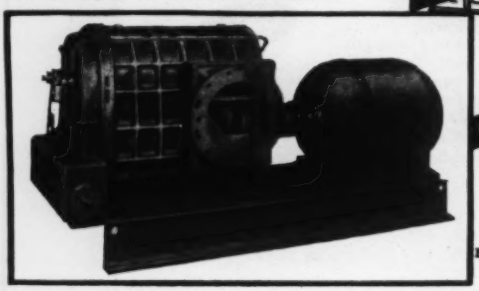

Standardaire 1218B23 Blower to deliver 2850 c.f.m. at 1160 r.p.m.

Engineers like the STANDARDAIRE principle

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Drop Hammer

A 25,000-lb steam-powered drop hammer, thought to be the world's largest spring-suspended installation, has been placed in the Vernon plant of the Aluminum Company of America, Los Angeles, Calif.

Forging major aircraft sections is the assignment in store for the new hammer. Standing approximately 18 ft above floor level, the hammer is foot-pedal operated by a three-man crew. A 12-in. intake line feeds steam into the overhead cylinder, lifting and dropping the weight.

Hammer, anvil, and base weighed a total of 75 tons and the entire mass rests on a 24-ft sq concrete inertia block located 21 ft under floor level and suspended on a network of steel beams. Ends of the beams are supported by 64 specially designed units bearing a total weight of 1,200,000 lb.

Purpose of the springs is to absorb both noise and vibration, resulting in savings to personnel and equipment.

Floor load at the hammer is figured at 10 tons on 4 wheels. This support is provided by a 30-in. steel beam installed to bear the weight of heavy dies transported to the hammer by fork-lift truck.

Surface-Resistance Indicator

A portable surface-resistance indicator, designed to help produce a better resistance welding bond by providing a rapid and accurate measurement of the resistance between pieces of metal to be welded, has been announced by the Special Products Division of the General Electric Co., Schenectady, N. Y.

The new device supplies a simple check on prewelding cleaning processes, upon which the surface resistance of the metal depends. Small changes in concentration or slight contamination of cleaning solutions cause surfaces resistance to vary widely, G-E engineers said, and ultimately result in an unsatisfactory resistance welding bond.

In resistance welding aluminum, for example, electrode pick-up, inconsistency of welds, and metal expulsion can be greatly reduced by knowing the surface resistance of the metal before welding, the engineers said.

The new equipment comprises two parts—a microhmmeter and a sample holder. The sample holder consists of an hydraulic ram which has a pair of current electrodes, emf electrodes, and a pressure gage. The emf electrodes are so spaced as to make the measurement independent of sample size.

In operation, the sample pieces of metal to be welded are placed between the jaws of the sample holder and subjected to the desired pressure. The surface resistance between the metal samples is indicated on the microhmmeter, which is connected electrically through an extension cable to the sample holder. The entire operation can be completed in a matter of seconds.

The unit has two ranges: 0–200 and 0–2000 microhms. The measured resistance is indicated directly in microhms on a linear 100-division scale. Voltage fluctuations in the supply mains do not affect the reading.

The microhmmeter is $9^1/_2 \times 15 \times 11$ in. and weighs 23 lb. The sample holder weighs 30 lb, has a clamp throat depth of 3 in., electrode clearance of 2 in., electrode surface radius of 4 in., and electrode diameter of $^5/_8$ in.

Mercury-Vapor Detectors

Two completely redesigned portable mercury-vapor detectors—the Type A (Electronic) and the Type B (Chemical)—for indicating concentrations of mercury which could be harmful to industrial workers, have been announced by the Special Products Division of the General Electric Co., Schenectady 5, N. Y.

The new detectors are expected to be used widely by manufacturers of electrical apparatus, instruments, bulbs and glassware, fur, salt, rubber, and by the chemical, metal mining, and smelting industries. The lighter, more compact instruments, G-E engineers said, will also prove helpful to insurance companies, public health departments, and laboratories.

The Electronic instrument is designed to give an instantaneous indication of mercury vapor by resonant absorption of ultraviolet energy. It will give instantaneous readings ranging from 0.01 to 3.0 milligrams of mercury per cubic meter of air, and features greater operational stability independent of line voltage. This is possible, the engineers said, because of an additional photo tube in a bridge circuit which measures the visible light, thus maintaining the bridge balance, although the line voltage may vary.

Accuracy for determination with the electronic detector is within ±5%.

The chemical-mercury-vapor detector operates on the principle that activated selenium sulphide, deposited upon a thin sheet of paper, will darken in the presence of mercury. It is designed for continuous monitoring and will indicate as little as 0.10 milligrams of mercury per cubic meter of air in two hours—the toxic limit for continual breathing of mercury vapor as established by the American Standards Association.

Housed in a small steel cabinet, the new chemical model has an increased sensitivity factor of approximately four. Its accuracy of determination has been increased over the earlier model by use of a thermoswitch and heater which holds the air sample constant. A blower is used to obtain a constant, positive air flow over the indicator paper, thus improving the dependability of its results.

Safety Relief Valve

A. W. Cash Valve Mfg. Corp., Decatur, Ill., has announced a new Type F-51 safety relief valve which has been tested and approved by the National Board of Pressure Vessel Inspectors, and is entitled to bear the ASME approval stamp. Intended for use on hot-water space-heating boilers, tanks, and heaters, the Type F-51 is available in pressure settings from 30 to 125 lb, with corresponding Btu ratings at various pressure settings. It was developed to conform with the recommendations of the National Board and ASME, wherein safety-relief valves should be sized according to the Btu generating capacity of the boiler. With the Type F-51 valve, it is a simple matter to install a valve which has a greater relieving capacity in Btu's per hr than the particular boiler can generate.

The Type F-51 safety-relief valve has sufficient capacity to relieve pressure both due to thermal expansion of water, as well as steam which is caused by failure of the firing device to shut off. It is an all-bronze valve, incorporating an exceptionally high lift design, stainless-steel spring, and silicone seat disk. The valve is priced competitively.

Protection
night and day

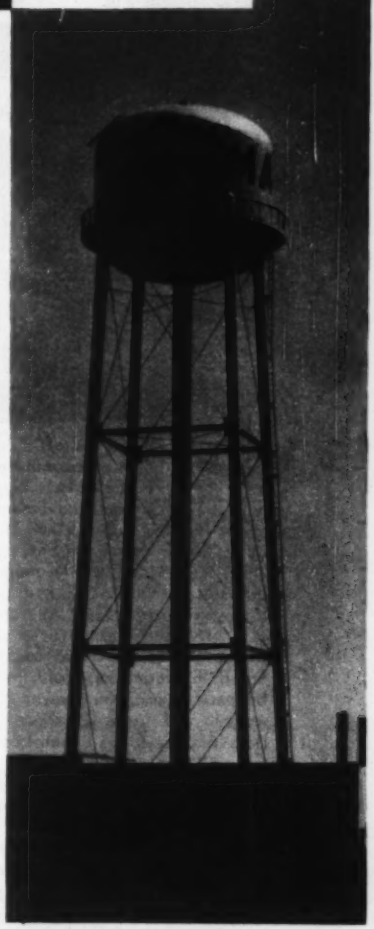
Dependable Water Supply at Mall Tool with HORTON TANK

Night and day fire protection in your plant calls for a dependable water supply—one that will stop fires while they are small—before serious property damage can occur.

A Horton elevated water tank, such as shown at the right, is always on guard, ready with a dependable flow of water to quench flames before they get out of hand. At the turn of a valve—or the opening of a sprinkler head—a steady stream of water can be brought to bear on the heart of the fire.

Horton ellipsoidal-bottom tanks are built in standard capacities from 15,000 to 500,000 gallons; Waterspheres from 25,000 to 250,000 gallons; and radial-cone tanks from 500,000 to 3,000,000 gallons. Write for complete information.

Right: This 100,000-gallon Horton ellipsoidal - bottom water tank, 100 ft. to bottom is located at one of Mall Tool Company's plants in the Chicago area. It supplies gravity water pressure for fire protection.



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Next winter, you'll appreciate the smooth flow of warmth from this Regulaire, the blower in the newest Perfection Furnace. The control permits movement of air in direct proportion to the furnace output, eliminating cold floors, chilly drafts, noisy blower operation and other discomforts of ordinary "blow cold—blow hot" heating. Chace Thermostatic Bimetal actuates the vane which restricts the blower outlet until the temperature reaches a comfortable level.

After the thermostat is set at desired temperature, burner (A) comes on at coasting fire, then turns to high fire if the rooms are cold. When the furnace bonnet (B) becomes warm, the blower (C) begins quiet delivery of warmth with vane (D) closed. Warm air is drawn down duct (E) and warms bimetal coil (F) which gradually opens vane (D) to gently increase flow of warm air to your rooms. It is this bimetal coil's sensitivity to the slightest change in temperature—plus a 3-stage burner—that regulates the flow of warmth to your rooms and assures perfect heating comfort in any weather.

Our 29 types of thermostatic bimetal are available in strips, coils, random long lengths and welded or brazed sub-assemblies. If the actuating element for your new control device is thermostatic bimetal, Chace can furnish it completely fabricated, ready for assembly. Our engineers, recognized authorities on temperature responsive devices, are available for consultation. Write today for our new 32-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing condensed engineering data.

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Plant Maintenance Operations

How a number of the country's leading industrial plants have effected new efficiencies and marked economies by employing fork-lift trucks and towing tractors in plant maintenance operations, is shown dramatically in a new 15-min motion picture, "Serves You Right!", released by the Clark Equipment Co.

This new movie, which is in black and white, with sound, also features the use of industrial radio in the operation of a fork-truck fleet working in both plant maintenance and materials-handling activities. Many of the sequences show ingenious employment of the fork truck in plant maintenance work, and contribute largely to the film's thought-provoking qualities.

"Serves You Right!" is available to plant executives, schools and colleges, transportation and materials-handling groups, foremens' clubs, and others with a legitimate interest in plant maintenance and materials-handling operations, on a loan basis, as are all other films listed in Clark's movie catalog. Requests for the movie should be addressed to the Clark Equipment Co., Industrial Truck Div., Battle Creek, Mich.

FHP Motor Slidefilm

A 35-mm, black-and-white, sound slidefilm and allied literature on "Selection and Application of Fractional Horsepower Motors" has been announced by the General Electric Company, Schenectady, N. Y. It is an addition to the company's Motor Selection Course, a training program launched last year as No. 22 in the G-E More Power to America series.

The new film (running time 21 minutes) describes the broad uses of FHp motors in the home, on the farm, in factories, and offices. It explains the five different kinds of motors in the FHp family: a-c single-phase types (capacitor, split-phase, and shaded-pole), and a-c polyphase and d-c types.

With photographs, charts, graphs, and cartoons, the slidefilm outlines the five basic steps that must be considered in selecting and applying any motor, and shows how they work in FHp sizes. It tells how to (1) study the driven machine, (2) determine the motor horsepower, (3) determine the electrical characteristics, (4) determine the control equipment required, and (5) determine mechanical design features.

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NEW EQUIPMENT
BUSINESS NOTES
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Low-Pressure Laminates

Low-pressure laminates with a remarkable degree of heat stability have been developed by Dow Corning Corp., Midland, Mich. Molded of glass cloth and Dow Corning 2104 Silicone Bonding Resin at pressures from 3 to 30 psi, they will withstand continuous exposure to temperatures in the range of 500 F and intermittent exposure to as high as 900 F.

Physical and electrical properties of these materials are comparable to those of conventional high-pressure silicone-glass laminates molded at 1000 psi or higher. Their mechanical strength is far superior to silicone-bonded moldings of chopped glass, mica, asbestos, or other inorganic fillers.

Finished laminates weigh less than aluminum or magnesium and are stronger than either at 500 F. Smooth, nonporous and easily machined, they are highly water repellant and resistant to most commonly used chemicals. Laminating stocks may be preformed and used to prepare complex shapes either by bag molding or in light metal molds. Flat sections can be laminated in thicknesses ranging from 0.01 to 2.00 in.

Low-pressure lamination is a comparatively recent innovation in molding technique which shows considerable promise. With it, large and complex parts can be produced with a relatively small equipment cost. Its development stems from the wartime introduction of organic bonding resins which had sufficient initial "flow" to permit the escape of air bubbles and which, at the same time, could change rapidly from a liquid to a gel—all without the use of high pressure.

However, these organic resins are useful only at operating temperatures below 350 F. For service at higher temperatures, low-pressure silicone-glass laminates were developed at Dow Corning by a research program based on Dow Corning 2104—the only commercially available silicone resin with the necessary properties. Dow Corning 2104 has a low initial viscosity at laminating temperature (345 F), and a gel time which may be controlled by the addition of a catalyst.

Press time for low-pressure silicone-glass laminates is only 15 min for an $^1/_8$-in. section. However, maximum heat stability calls for an afterbake of from 100 to 170 hr at 500 F. In many applications, of course, high ambient temperatures may effect this afterbake during actual use, eliminating most of the oven-curing time.

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Capacities To — 1000 GPM
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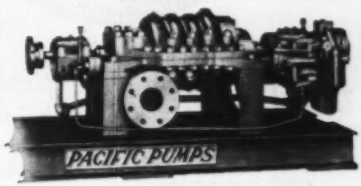
Speeds To — 10,000 RPM



THE Pacific
SINGLE STAGE-UNITIZED
STEAM TURBOPUMP

Capacities To — 500 GPM
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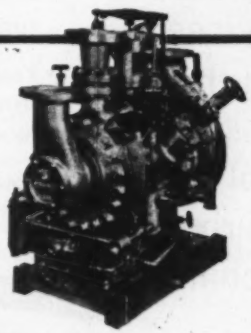
Exhaust Pressures To — 50 psi
Speeds To — 10,000 RPM



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BF-15

Optical Gaging

A new 16-mm sound motion picture which demonstrates and explains the principles of optical gaging and shows how optical gaging is being used in modern mass production and inspection has been completed by the Eastman Kodak Co., Rochester, N. Y.

The film, "Optical Gaging" will be available on loan to industrial, educational, and professional groups through Engineer Specialties, 980 Ellicott St., Buffalo, N. Y.

The new film has a running time of 22 min. Its purpose is to promote a broader understanding of optical gaging and to explain the principles on which it operates.

In the film, the basic principles of optical gaging are discussed and demonstrated with various staging fixtures. The procedure used in designing fixtures is shown, and as a further example a comparison is presented that shows the results when one part is inspected by both mechanical and optical gaging.

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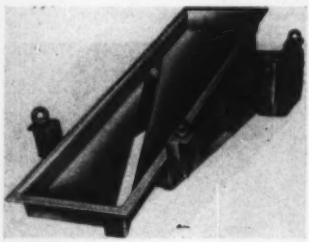
Vibrating Spreader Feeder

Syntron Co., 498 Lexington Ave., Homer City, Pa., announces a new style vibrating spreader feeder for providing a continuous curtain of such bulk materials as roofing granules, calcium chloride, nut meats, etc., in numerous food and industrial processes.

The spreader feeder is made up with a flat pan trough having a diagonal slot and powered by a single electromagnet drive. The latter may be mounted either above or below the flat pan trough, depending upon the room available.



The rate of feed is controllable—merely by turning the feed control knob in the separate control box, until the desired feed rate is reached.

In operation, the feeder's vibratory action flows the material out along the trough, discharging it along the edge of the slot to form a constant, even curtain of material that is 2 to 4 times the width of the original material stream.

The spreader feeder is available in several sizes and capacities.

Catalog data, specifications, and information are available from the manufacturer.

Business Notes

B & W Move to New Headquarters

The Babcock & Wilcox Co. opened offices recently at new headquarters in the 32-story fully air-conditioned Chrysler Building East at 161 E. 42 St., New York, N. Y., following one of the largest moves from the financial district in many years. It required about 220 truckloads to transfer the company's thousands of desks, files, office machines, and library records from the old headquarters at 85 Liberty St. The company has had its general office in the downtown district of New York for more than three quarters of a century.

The company has a research center, and eight manufacturing plants, in Ohio, Western Pennsylvania, Georgia, Mississippi, North Carolina, and Texas. It employs approximately 14,000 people, of which 825 are in the New York office. Its products are separated into five general groups—stationary boilers, marine boilers, tubes, refractories, and special products.

Sales offices of The Babcock & Wilcox Company's Tubular Products Div. will not be affected by the move, and will remain in their present location at 22 E. 40 St.

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NEW EQUIPMENT
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Alcoa Purchases Screening Manufacturing Equipment

Aluminum Co. of America, Pittsburgh, Pa., has purchased the equipment for manufacturing insect wire screening formerly owned and operated by the Woven Wire Fabrics Div. of the John A. Roebling's Sons Co. Alcoa will use this equipment for the manufacture of aluminum insect wire screening. The equipment, now located at Roebling, N. J., will be moved to an Alcoa plant for reconditioning. The company has not yet reached a decision as to where the wire weaving operations will be located. It is anticipated that Alcoa will be producing aluminum screening by the latter part of the current year.

Hagan Forms new Aero and Special Products Division

Hagan Corp. of Pittsburgh, Pa., combustion and chemical engineering firm, is announcing establishment of its new Aeronautical and Special Products Division "to meet a growing demand for high performance regulating and measuring devices" in aeronautical engine testing, gas-turbine controls, blower controls, thrust and torque measurement, and similar problems. Hagan has formed the new engineering and sales division as an outgrowth of expanding demand for its engineering services in such projects as the Engine Test Laboratory at Wright-Patterson Air Force Base, Arnold Engineering and Development Center of U. S. Air Force, Tullahoma, Tenn., U. S. Naval Aeronautical Engine Test Laboratory, Trenton, N. J., Willgoos Engine Test Facility of Pratt & Whitney Div., United Aircraft Corp., and others. Initial work of the new division will be the development of controls in the fields of aeronautical engine and guided-missile testing, wind tunnels, atomic power plants, industrial gas turbines, centrifugal blowers, force-measuring systems, and other applications involving special metering problems in air flow and fuel flow.

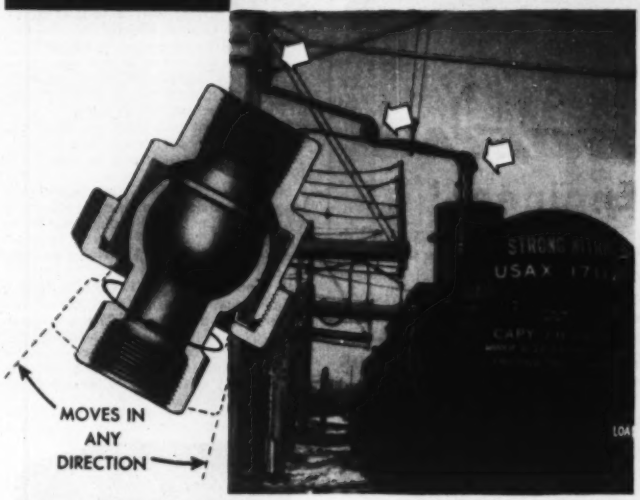
Union Carbide to Construct New Unit

Construction of a major unit for the production of polyethylene resins has been announced as an addition to the Texas City plant of Carbide and Carbon Chemicals Co., a Division of Union Carbide and Carbon Corp., New York, N. Y. The unit is expected to be in production by early 1953.

The production process will involve the direct polymerization of ethylene at high pressure. The resulting "solidified" material will be in the form of whitish, resin granules.

The estimated production of this unit is 50 million lb a year. It has been estimated, furthermore, that the total U. S. annual production of polyethylene, from Carbide's Texas City and South Charleston plants and from other producers, will be between 100 and 150 million lb by the end of 1952. It is anticipated that the entire production of the Texas City unit will go into the defense effort. It is also expected that by the end of 1952, the military requirements for applications of extreme urgency will still be in excess of the country's ability to produce polyethylene. These requirements will continue to increase during 1953 if the rearmament program continues at its present rate.

BARCO Flexible BALL JOINTS



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4. STAINLESS STEEL BODIES. Also regularly furnished in Malleable Iron, Steel, Bronze, Aluminum, and Magnesium. Other special alloy joints to order.
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NEW EQUIPMENT
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G. E. to Build New Transformer Plant

A multimillion-dollar transformer manufacturing plant, providing employment for about 1700 persons, will be built at Rome, Ga., by the General Electric Co. Its construction will be completed by mid 1953.

The plant will consist of two large anufacturing buildings, an office building, and a number of outlying service buildings, all constructed of steel and transit siding.

Production at new plant will begin immediately on its completion, with full production capacity expected to be achieved in 1955.

Some classes of power transformers and large distribution transformers, representing a total of $5^1/_2$-million kilivoltamperes or the equivalent of $7^1/_2$ million hp of electrical energy, are expected to be produced annually at the new facilities.

Transformer ratings to be manufactured at the new plant will range from 300 kilivoltamperes to a maximum of 7500 kilivoltamperes, 69 kilivolts and below. Included will be liquid-filled transformers of conventional type, transformers for load center unit substations and master unit substations, and network transformers.

Latest Catalogs

Two-Drum Boilers

A new bulletin covering two-drum boilers (Class VF-VS) is available from Henry Vogt Machine Co., Louisville 10, Ky.

Spreader Stokers

A 16-page illustrated bulletin on "Spreader Stokers" has been published by Erie City Iron Works, Erie, Pa. It covers the dumping-grate type and travagate.

Spray Nozzles

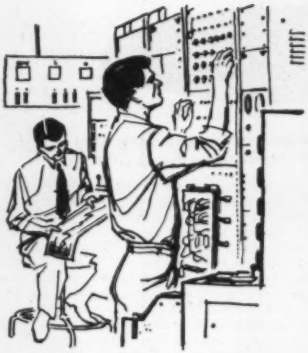
Bulletin No. 58, available from Spraying Systems Co., 3201 Randolph St., Bellwood, Ill., covers nozzles and fittings for agricultural spraying. The market for these sprays is among manufacturers who build outfits of various types for agricultural spraying.

Watthour and Demand Meters

A handy, 52-page pocket guide for the selection and installation of G-E watthour and demand meters is available from General Electric Co., Schenectady 5, N. Y. Designated as GET-2376, the booklet contains simplified selection tables, descriptions of the meters, and clear-cut wiring diagrams of the various watthour and demand meters used in most systems.

Materials Handling

Report No. 244, another in a continuing series of materials-handling case studies is available from The Baker-Raulang Co., 1230 W. 80 St., Cleveland, Ohio. It tells how United Stove Co., Ypsilanti, Mich., saved the cost of a new loading dock by using a fork truck with a revolving head attachment for its shipping work.



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FOR POWER TRANSMISSION
REQUIRE NO MAINTENANCE

Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

Thomas Couplings have a wide range of speeds, horsepower and shaft sizes:

½ to 40,000 HP
1 to 30,000 RPM

Specialists on Couplings for more than 30 years

BACKLASH FRICTION WEAR and CROSS-PULL are eliminated

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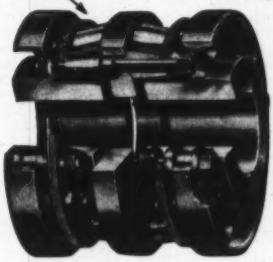

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CATALOGS

Spongex Plastic

The first printed literature prepared on Spongex Plastic, an expanded unicellular polyvinyl chloride, is available from the Sponge Rubber Products Co., Shelton, Conn.

O_2 and H_2 Analyzers

Bulletin 148 BP issued by Cambridge Instrument Corp., Grand Central Terminal, New York, N. Y., contains information on Cambridge Dissolved O_2 and H_2 Analyzers, and descriptive matter on industrial pH meters.

Chemical Pumps

Bulletin No. WQ-213, 4 pages, contains exterior and sectional views, special features, specifications, dimensions, selection chart, etc., on process and medium duty chemical pumps. Available from Warren Steam Pump Co., Inc., Warren, Mass.

Silicones

"What's a Silicone?" is a 32-page booklet published by Dow Corning Corp., Midland, Mich., describing and illustrating the use of silicones in polishes, water repellants, fluids, release agents, lubricants, defoamers, Silastic—the Dow Corning silicone rubber, protective coatings, and electrical insulations.

Selenium Rectifier Stacks

A new 28-page, two-color booklet describing the basic characteristics and the applications of selenium rectifier stacks has been announced by the Lighting and Rectifier Dept. of the General Electric Co., Schenectady 5, N. Y.

Designated as GET-2350, the booklet is complete with charts, graphs, and tables illustrating the principles of rectification, and the characteristics, manufacture, circuit design, and application of selenium rectifiers.

Flexible Shafting

A 62-page booklet, form 400, entitled "Flexible Shafting," has been published and is available from F. W. Stewart Mfg. Co., 4311-13 Ravenswood Ave., Chicago, Ill. Many applications and uses of the flexible shaft are covered. Also the many types of end fittings, casings, adapters, and shaft combinations, have been included to show the variety of standard sizes and types of shafts that are available.

Pressure Vessel Accessories

Complete engineering data and specification details on Lenape pressure vessel accessories are included in a 64-page catalog, No. 9-49, available from Lenape Hydraulic Pressing and Forging Co., West Chester, Pa. Sectionalized for easy reference, the company's line of welding necks, manways, nozzles, covers, rings, studding outlets, saddles, fittings, and other press-formed specialties is factually presented with complete dimensional data, pressure ratings, code specifications, construction details, and service recommendations. Illustrations of all products, both in photograph and blue print style are provided, together with installations and applications pertinent to the advantageous use of each item.

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ROUND HEAD BOLTS

In this Revision the depth of square of ordinary carriage bolts has been changed to use the limits previously applying to short lengths. Besides dimensions of carriage, button head, step, and countersunk bolts, dimensions of elevator and T-head bolts, and an extremely short neck carriage bolt have been added. The Standard also specifies threads, length tolerances, and materials.

B18.5-1952 $1.00

STAINLESS STEEL PIPE

New Standard presents dimensions of eighteen sizes of welded and seamless stainless steel pipe ranging from ⅛ inch to 12 inches. Besides the three weight and thickness schedules—(10S, 40S and 80S) of the former Standard, a fourth schedule—5S has been added.

B36.19-1952 $1.00

ACCURACY OF ENGINE AND TOOL ROOM LATHES

This new Standard gives the tolerances to which industry is building 12 in. to 18 in., 20 in. to 32 in., and 40 in. to 72 in. lathes. Tests by which accuracy of lathes may be determined are also given.

B5.16-1952 $1.00

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STUB ACME SCREW THREADS

This Standard, also a revision of the 1945 publication, is limited to one class of thread, corresponding to the 2G general purpose Acme thread. Specified are the angle, height and thickness of the thread; allowance at major and minor diameters; the basic dimensions; special diameters; and the selected series of diameters and pitches. Appendixes give basic data for two modified forms of Stub Acme threads having basic thread heights of 0.375 and 0.25 pitch, respectively.

B1.8-1952 $1.25

ACME SCREW THREADS

A revision of the 1945 document, this 1952 Standard specifies three classes of general purpose and five classes of centralizing threads, and gives basic dimensions, tolerances and allowances, and limiting dimensions for the standard series of diameters and pitches. Formulas for special diameter-pitch combinations are included, also appendixes dealing with gages for both threads and an alternative series of centralizing threads with minor diameter centralizing control.

B1.5-1952, $2.25

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Hot Process Softeners

Permutit Co., 330 W. 42 St., New York, N. Y., announces availability of Bulletin 2341, a 32-page booklet, which fully describes hot-process water softeners and discusses their application in the field of boiler feedwater.

Deaerating Heaters

A new bulletin, No. WC 106, on tray-type deaerating heaters has just been printed by Graver Water Conditioning Co., Dept. 21-6, 216 W. 14 St., New York 11, N. Y. An introductory section of the bulletin explains the principles of successful deaeration and the essential elements of a deaerating heater. The features of Graver tray-type and spray tray-type heaters are described in tabular form for greatest clarity, and illustrated by detailed drawings with identification of all parts. Included in the bulletins are also flow diagrams and photographs of typical Graver heater installations.

Air Conditioning

A 60-page catalog of Westinghouse-Sturtevant products for "putting air to work" is now available from the Westinghouse Electric Corp., Box 2278, Pittsburgh 30, Pa. The two-color General Product and Application Catalog is divided into three sections: (1) a 21-page equipment section; (2) a 14-page "putting-air-to-work" application section; and (3) a 16-page engineering data section.

Thermistors

A new 30-page catalog, No. TH-5, describing Carboloy Thermistors is available from Carboloy Dept. of General Electric Co., Detroit 32, Mich. The catalog contains general basic information relating to physical and operating characteristics of Thermistors, which are electronic semiconductor control elements whose electrical resistance responds negatively to minute temperature changes. Typical Thermistor applications and wiring diagrams are listed. Graphical data of temperature-resistance ratio characteristics for rod, disk, and washer-types are included.

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Axonometric Drawing

An illustrated booklet covering axonometric drawing is available from John R. Cassell Co., Inc., New York, N. Y.

Centrifugal Sump Pumps

Warren Steam Pump Co., Inc., Warren, Mass., announce improved models of Types VS and VN sump pumps. These are illustrated and described in an 8-page, 2-color bulletin No. WQ-220. Warren-Quimby VS and VN sump pumps are available in wet and dry pit types and are adapted to handling clear liquids, sewage, and other liquids containing solids. Sizes, $1^1/_2$ to 8 in., capacities to 1000 gpm, and pressures up to 250 psi.

Clad Metals

The new lead clad metals are becoming so important in so many industries and are solving so many design and process problems that it is essential for engineers, designers, and technicians to understand their characteristics. For this reason, a 22-page booklet has been published by Knapp Mills Inc., 23-15 Borden Ave., L. I. C., N. Y., on "The History and Development of Ferrolum Lead Clad Steel and Cupralum Lead Clad Copper."

Circuit Breakers

A complete study of Type AB circuit breakers is given in a new 35-page booklet, No. B-5407, available from the Westinghouse Electric Corp., Box 2278, Pittsburgh 30, Pa. For the first time, photographs show the actual De-ion arc quenching action of all AB breakers: confine the arc, divide it, extinguish it. A "quick guide" to AB circuit breakers gives the types, their ratings and standard and special features.

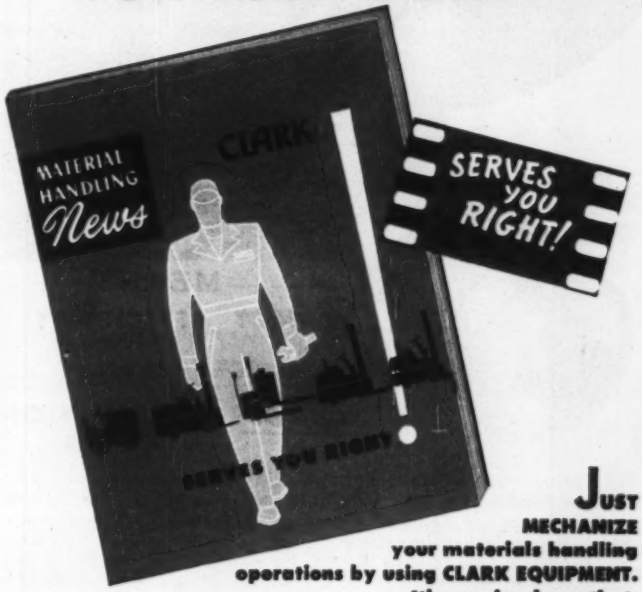
Optical Gaging

A new publication, "Optical Gaging," which describes some of the more recent developments in optical gaging is available from the Eastman Kodak Co., Industrial Optical Sales Div., Rochester 4, N. Y. The paper points out that accuracy, speed, and economy may all be achieved in modern production gaging and inspection through the use of optical gaging techniques. There are descriptions of the elements of an optical gage and the charts used in inspection. Staging fixture principles and desirable characteristics in an optical gaging projector are outlined.

Bin Level Indicators

The Bin-Dicator Co., 13946-96 Kercheval, Detroit 15, Mich., announces a new 1952 catalog describing and illustrating the company's products. Bin-Dicator markets a complete line of bin level indicators which are widely used throughout industry to indicate the level of granular and pulverized materials stored in tanks, silos, hoppers, and bins. These units also actuate various types of signals, if required, and can be used to start and stop loading and filling machinery, as required by the level of content in the storage unit. The new catalog supplies complete installation data for the various types of units; for thin or thick-walled bins, for inside or outside location, and for suspended interior installation.

HOW TO GET THE MOST FOR YOUR MONEY!



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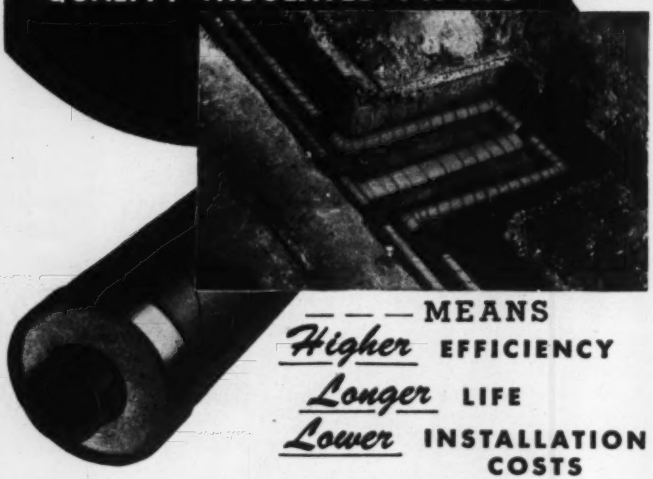

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UTILIDOR TYPE CONDUITS

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NEW EQUIPMENT
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LATEST CATALOGS

Floating Roof Tanks

Graver Tank & Mfg. Co., Inc., East Chicago, Ind., announce availability of a new bulletin on double-deck floating roof tanks. Operating features, seal and seal mechanism, product conservation, etc., are discussed.

Vacuum Deaerator

A colorful 8-page bulletin, No. 3698, describing the new Vacuum Deaerator has been compiled by The Permutit Co., 330 W. 42 St., New York, N. Y. The bulletin outlines how the apparatus removes oxygen and free carbon dioxide from water so as to protect piping, steel tanks, and other equipment from the harmful effects of corrosion.

Arc-Welding Accessories

Three new two-color bulletins on arc-welding accessories have been announced as available from the General Electric Company, Schenectady 5, N. Y. The three illustrated bulletins describe recommended protective clothing (GEC-867), helmets and glass (GEC-865), brushes, carriers, chipping hammers, paint and weld-spatter compounds and weld gages (GEC-866). In addition to illustrating and describing the equipment, the bulletins list specifications, type, and catalog numbers for each item.

Moly-Sulfide

Climax Molybdenum Co., 500 Fifth Ave., New York, N. Y., has issued a booklet describing the uses of Moly-sulfide as an effective lubricant. It is well-suited for prevention of galling and seizing even of the softest metals. In addition, its main uses are: as an aid in the assembly and disassembly of closely fitting parts; as a lubricant in hot and cold-working and forming of metals; as a lubricant for parts that must function properly at high and low temperatures; as a non-dust-collecting lubricant; as a dielectric lubricant.

Flame-Hardening

Flame-hardening, an efficient and economical method of hardening steel parts, is described in a new, 8-page, illustrated booklet, "Flame-Hardening—A Flexible Method of Surface Treatment." The booklet lists the advantages of flame-hardening, and steel that can be hardened. Illustrations of several different types of applications show the wide variations that can be obtained from this process. Available from any Linde office or direct from Linde Air Products Co., a Division of Union Carbide and Carbon Corp., 30 E. 42 St., New York 17, N. Y.

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Industrial Television

A bulletin, Na 1025-A, that describes the new Model 300-B Diamond "Utiliscope" (Wired Television), is available from Diamond Power Specialty Corp., Lancaster, Ohio.

Adjustable Flow Valves

Catalog No. 713 on adjustable flow valves is announced by Hauck Mfg. Co., 124–136 10 St., Brooklyn 15, N. Y. The unique feature of the flow curve being adjustable at 10 dial positions, affords an infinite flexibility of flow characteristics. Available in single or dual assemblies, and straight through or angle types, these valves are of real advantage in automatic flow control systems for gas or air.

Electronic Surge Comparison Tester

Complete information on the industrial electronic surge comparison tester is now available in a new 8-page descriptive bulletin, No. DB 85-960, from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. The tester is used mainly to locate insulation faults and winding dissymmetries in various electrical apparatus. Detailed specifications of both models, the portable and the mobile, are given along with considerations on their respective versatilities of application; examples of various applications are presented in photos. The bulletin also gives diagrams and descriptions of test connections for two-coil comparison, three-phase, and surge-induction tests, with recommendations as to where these tests might best be used.

Squirrel-Cage Induction Motors

Construction features of their drip-proof and splashproof squirrel-cage induction motors are described in a new bulletin, No. 51B7693, released by Allis-Chalmers Mfg. Co., 949 S. 70 St., Milwaukee, Wis. The bulletin relates that the drip-proof motors (Type AW) are available in all ratings in NEMA Design B, which is suitable for the majority of cage motor applications. Many ratings are available in NEMA Design C, for applications requiring high locked-rotor torque and normal breakdown torque. Special modifications, in addition to splashproof construction (Type AWW), include vertical mounting, flange mounting, and multispeed construction.

Crane Cab Coolers

A complete line of crane cab coolers and conditioners is described in a new 24-page, illustrated bulletin available from Dravo Corp., Air Conditioning and Combustion Dept., Dravo Bldg., Fifth and Liberty Ave., Pittsburgh, Pa. Designed to maintain comfortable working conditions and to supply clean, pure air under virtually all atmospheric and temperature variations, Dravo Crane cab coolers and conditioners are now available in several models to meet every requirement. The bulletin points out that use of this equipment safeguards the health of crane operators and increases efficiency and alertness with resultant improvement in over-all safety and production. Functions of the equipment include dust and dirt removal, fume and odor removal, winter heating, and summer cooling.

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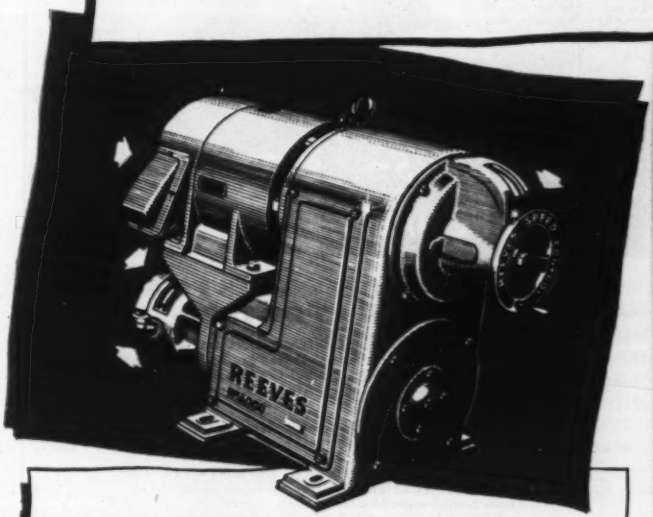

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Tracing Cloth

A new 4-page, two color booklet, No. A-2029, describing the new Brutex Tracing Cloth which has been developed by Bruning's research department after years of experimentation, is available from Charles Bruning Co., Inc., Teterboro, N. J.

Regulating Valves

A new bulletin, No. 513, on double-sealed diaphragm regulating valves for use with control instruments has been issued by Leslie Co., Delafield Ave., Lyndhurst, N. J. The bulletin describes and outlines the special features of the new "Class DV" double seated diaphragm regulating valves. Chief among these features is the "Flow-Line contoured body" which provides high capacity at low pressure drop. Featured also are valve's standard ISA face-to-face dimensions.

Multi-Cycle Electric Tools

Ingersoll-Rand Co. has published a comprehensive 36-page catalog, Form 5111, covering their complete line of Multi-Cycle electric tools. The catalog is divided into eight sections; Impactools, Nut Runners, Drills, Screw Drivers, Grinders, Buffers, Sanders, and Polishers. Over 100 different sizes are listed covering both 180 and 360-cycle models. Complete lists of equipment and accessories are also included. For a copy of this Multi-Cycle Electric Tool Catalog, write to nearest Ingersoll-Rand branch office, or Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

FHP Gear-Motors

A new 8-page, 2-color bulletin on fractional-horsepower gear-motors listing 61 standard models from which to choose is available from the General Electric Co., Schenectady 5, N. Y. Designated as GEA-5678, the publication describes the applications for FHP gear-motors and outlines a simple method of determining correct horsepower requirements with the use of an ordinary pipe wrench and fish scale. The bulletin contains descriptions, cutaway drawings, selection charts, and dimension tables for both concentric-shaft and right-angle shaft gear-motors; includes a section on maintenance pointers, and a complete list of G-E apparatus service shops throughout the country.

Ratio Totalizer

The improved design of the Hagen ratio totalizer is described and pictured in Bulletin No. 5452, issued by Hagan Corp., P. O. Box 1346, Pittsburgh 30, Pa. The Hagan Ratio Totalizer is a pneumatically operated control mechanism, almost universally applicable for accurately combining input control pressures and spring forces, and producing an output control pressure based on addition, subtraction, multiplication, division, or more complicated functions of the input control signals. The output signal represents any desired combination of the input signals. A maximum of three input signal pressures plus three spring pressures can be accommodated in a single unit. Accuracy of output signal is said to be within 1% of full-scale reading.

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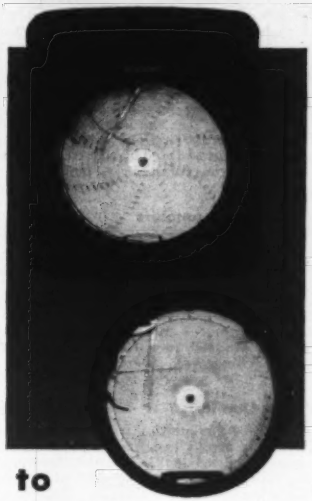

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Drill Press Feed

A new 16-page illustrated booklet, No. AV-100, issued by The Bellows Co., Akron, Ohio, covers the company's drill press feeds, which are "packaged" pneumatic devices designed primarily to provide automatic or semiautomatic feeding of drill press spindles. They are readily adaptable, however, for power feeding a wide range of machine tools, such as tapping machines, milling machines, grinders, threaders, etc.

Industrial Furnaces

A new 38-page booklet, No. B-5459, available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa., tells how to match a furnace to your particular heat-treating problem. This new booklet, entitled "Harnessing Heat" describes each of 12 different types of furnaces—both gas and electric— and briefly outlines their chief field of application. A section devoted to special furnaces gives several typical examples of tailor-made furnaces designed to meet specific problems of heat-treatment and production rates. A protective atmosphere section describes the four basic types of protective atmospheres available—Endogas, Exogas, Monogas, and Ammogas—and gives combinations and applications of these types as well as descriptions of available accessories.

Small Purifiers

A new 6-page bulletin, No. 500, has been published describing the small line type Hi-eF purifier recently developed by the V. D. Anderson Co., 1935 W. 96 St., Cleveland, Ohio. In this folder are listed many functions of this new unit which is used to clean up small pipe lines carrying live or exhaust steam, vapors, and air. These include applications on steam drums, ejectors, steam-jacketed kettles, heat exchangers, vacuum canning equipment, laundry and dry cleaning equipment, intercoolers for gas compressors, air tools, spray painting, etc. In addition the bulletin describes the advantages which result in the use of these purifiers on the above applications such as (1) increased production efficiency, (2) reduced maintenance costs, (3) improved products. The folder also contains diagrams of typical installations, specifications and prices of these units which range in size from $\frac{1}{2}$ to 2 in.

Foundry Mechanization

How a foundry can be mechanized for increased production, better castings, and improved working conditions is the topic of a new book, No. 2439, published by Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill. This is a selection of actual case histories, foundry layout drawings, and installation photographs. Dramatic contrasts are made between original methods and modern mechanical handling in molding, pouring, cooling, and sand preparation through use of sand reconditioning machinery shakeouts, and conveyers for molds, sand, and castings. A typical case history describes how mechanized sand and castings handling equipment boosted melt from 60,000 to 100,000 lb per shift and reduced manual lifting from 1470 to 294 tons per day. Foundries handling gray iron, malleable, steel, brass, aluminum, magnesium, and other metals are represented.

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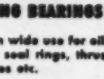

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Compressed Air Products

A general catalog covering compressed air products is available from Jas. A. Murphy & Co., Hamilton, Ohio. Included are aftercoolers, separators, traps, spray guns, and pistol sprayers.

Fans

Chelsea Fan & Blower Co. of Plainfield, N. J., has issued a complete catalog, price sheet, and engineering bulletin describing 30 fan types in over 300 sizes. Included are complete specifications, dimensions, installation diagrams and product photographs, as well as extensive information on the proper selection and installation of fans for every industrial, commercial, and residential requirement.

Zeolite Softeners

Cochrane Corp., Philadelphia 32, Pa., has issued a revised edition of their bulletin on Sodium Zeolite Softeners. The bulletin, No. 4520-A, gives a detailed explanation of zeolite water softening, including a glossary of terms used in the process, data for laying out a zeolite softening plant, the factors governing the size of equipment, the selection of zeolite materials, and a detailed description of the four stages of operation of a sodium zeolite softener. A complete description of the Cochrane Hydromatic Single Control Valve is included.

Centralized Instrumentation

Bulletin No. 85-20, consisting of 32 pages, describes conventional and graphic type panelboards, as well as the measuring and control instruments utilized. Available from Minneapolis-Honeywell Regulator Co., Station 40, Wayne and Windrim Aves., Philadelphia 44, Pa.

Power Piping Design

A bulletin recently issued by Taylor Forge & Pipe Works, Chicago 90, Ill., is a reprint of an article written by Sabin Crocker on the subject "How to Use Schedule Numbers in Power Piping Design". The charts Mr. Crocker used in his original paper have been amplified. The foreword to this bulletin outlines the scope and indicates what it is designed to accomplish.

Water Conditioning

A 102-page data book for practicing engineers and those who work with water-conditioning problems, has been compiled by and is available from Permutit Co., 330 W. 42 St., New York, N. Y. Some of the subjects covered include: Hydraulics, Impurities in Water, Chemicals used in Water Treatment, Cold Lime Process, Hot-Lime Soda Process, Boiler Feedwater Make-up Requirements, Alkalinity Relationships, Specific Gravities, etc.

Lightweight Soldering Iron

A new bulletin, GED-1583, describing the new G-E lightweight soldering iron is available from the General Electric Co., Schenectady 5, N. Y. The new iron is designed especially for radio, electronic, and instrument manufacturers who need high-speed pin-point soldering accomplished in close quarters.

U-Tube Manometers

A print No. 828 and Data Sheet U-51 covering the new Uehling Type B straight tube U-tube manometer, with scales ranging in lengths from 10 in. to 100 in., graduated in in., $^1/_{10}$ in. of water, or $^1/_4$ in. of water, or in in. of mercury, in tenths, or in any other equivalent units such as lb, oz, mm, grams, etc., is available from Uehling Instrument Co., 473 Getty Ave., Paterson, N. J.

Gear Quality

A new paper which clarifies the data required to specify and test spur and helical gears is offered in "A Practical Approach to Gear Quality" by the Eastman Kodak Co., Industrial Optical Sales Div., Rochester 4, N. Y. The paper outlines the minimum information necessary for an intelligent approach to the testing of gears. It refers to the standards developed for fine-pitch gears (20 D. P. and finer), but the ideas are applicable to gears of coarser pitch as well.

"We have used your Bin-Dicators in our fertilizer plant for some time and would not be without them. I can show you a case where a single Bin-Dicator replaces a man," writes a New England manufacturer.

BIN-DICATOR "keeps an eye" on levels of bulk materials in silos, hoppers, bins, chutes and automatically reports to central control point. Prevents over-filling; prevents overfeed and underfeed to conveyors and filling equipment; prevents delays and waste. Low cost, easy to install, simplest operation. Widely used.

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NEW 1952 CATALOG FREE

THE BIN-DICATOR CO.
13946-W Kercheval • Detroit 15, Mich.

BLAW-KNOX GRATING

Electroforged into rigid, one-piece panels.

Twisted cross bar prevents slipping.

...GIVES BETTER SERVICE ON 5 COUNTS

1 SAFER FOOTING
2 GREATER STRENGTH
3 LONGER LIFE
4 LOWER MAINTENANCE
5 MORE OPEN SPACE

Bring your open steel flooring problems to Blaw-Knox for expert help. Bulletin 2365 sent on request.

BLAW-KNOX DIVISION of Blaw-Knox Company
2105 Farmers Bank Bldg., Pittsburgh 22, Pa.

BLAW-KNOX *Electroforged* STEEL GRATING

Important Information Concerning

Jet Aircraft Equipment

THE SWIFT ADVANCE of the jet and propeller turbine has opened new fields for research, development and manufacture of jet aircraft equipment.

Every stage—from design to production—of such products as turbine engine starters, turbine engine fuel controls, air-cycle refrigeration units, hydraulic pumps and auxiliary drives and controls for guided missiles, presents a new and fascinating challenge for the engineering mind.

Already the Hamilton Standard Division of United Aircraft Corporation—the recognized leader in the propeller field—is deep in this aircraft equipment field. The projected program is the largest in its history because the new products will be vital to commercial and military aviation alike in the coming years.

We want men who would like to pioneer in new fields — do *creative* engineering — enjoy freedom of decision — and want to build a sound career with other young-minded men in an industry with a future.

At our new 10 million dollar plant in Windsor Locks, Connecticut—right in the heart of beautiful New England—you'll find excellent working and living conditions. It is near enough to major Eastern cities and sea and mountain resorts to offer every cultural and recreational advantage.

Our employee benefits include group health, accident, hospitalization and life insurance, retirement income plan, paid vacations, and a liberal sick leave policy. Our progressive policy will provide ample opportunity for your future growth. *Actually, our technical engineering staff has continuously grown since the beginning of the Hamilton Standard organization.*

IMMEDIATELY

WE NEED 115 EXPERIENCED ENGINEERS AND DESIGNERS

Design, development and test engineers with initiative and resourcefulness will find full opportunity at Hamilton Standard because of the newness of the jet equipment field itself. The company's extensive facilities—its staff of youthful, yet extremely high calibre men—its policy of recognizing talent and idea—its practice of quickly assigning responsibility—and its continuous habit of promoting from within—may well be the conditions you have in mind for a satisfying lifetime career.

Simply send your resume to the Engineering Representative, Personnel Department, at the address listed below. It will be held in strictest confidence.

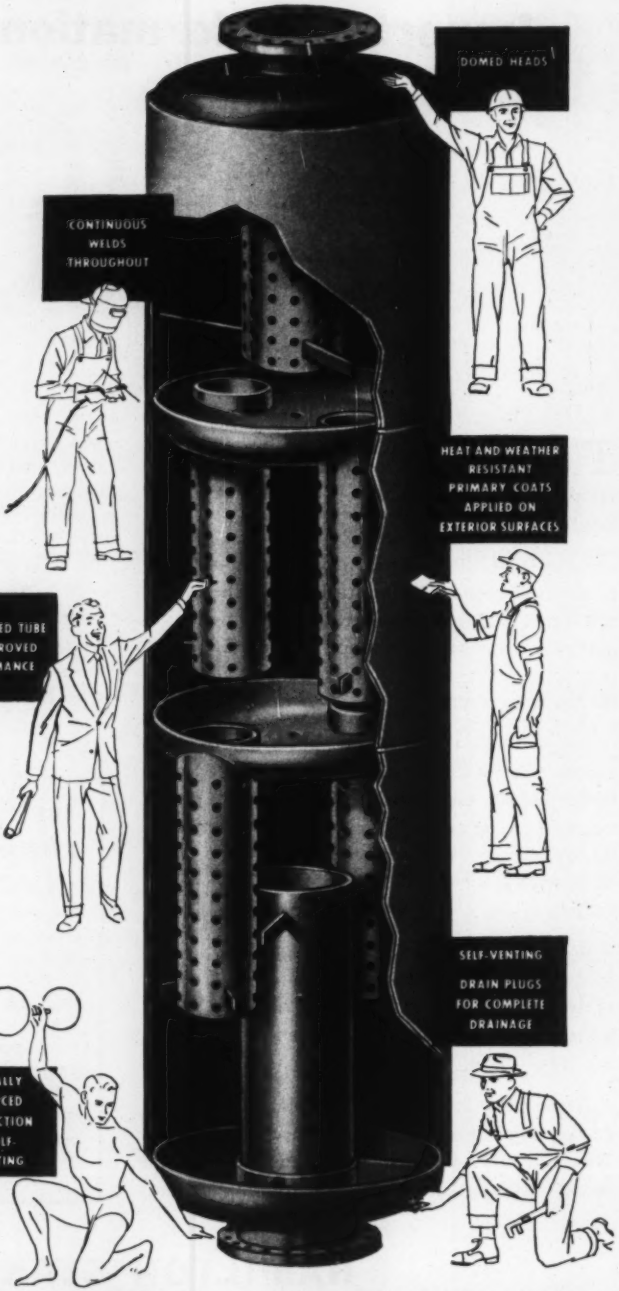
HAMILTON STANDARD

DIVISION OF UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONN.

Rugged Reliable Snubbers*

for quiet operation of engines and compressors


DOMED HEADS
CONTINUOUS WELDS THROUGHOUT
HEAT AND WEATHER RESISTANT PRIMARY COATS APPLIED ON EXTERIOR SURFACES
PERFORATED TUBE FOR IMPROVED PERFORMANCE
SELF-VENTING DRAIN PLUGS FOR COMPLETE DRAINAGE
INTERNALLY REINFORCED CONSTRUCTION AND SELF-SUPPORTING

Burgess-Manning Snubbers are soundly engineered, carefully fabricated by craftsmen from quality materials. Burgess-Manning Snubbers are built to meet the rugged operating conditions encountered in the field.

Snubbers are available to meet the exacting noise reduction requirements of your Diesel and gas engines, jets, turbines, blowers, compressors, and vacuum pumps.

* Choice of Snubbers from industrial silencing level to critical installations such as hospitals, hotels, office buildings, and residential areas.

BURGESS-MANNING COMPANY

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Kodak Conju-Gage Gear Checkers automatically write records to ship with gears or hold for reference—records that show the composite effects of runout, base pitch error, tooth thickness variation, profile error, and lateral runout. Illustrated is the Kodak Conju-Gage Gear Checker, Model 4U, for gears up to 4½" pitch diameter. There are also larger and smaller models.

you have the proof..

with the

Kodak Conju-Gage Gear Checker

For fast checking of precision gears to the closest tolerances

When gear specifications limit tooth-to-tooth composite error to .0002", it's not easy to be sure you've met them—if the master you're checking against is no better.

A Kodak Conju-Gage Gear Checker gives you the proof, eliminates arguments because it conforms to the composite gear-check principle recommended in the new American Standard (AGMA 236.03, ASA B6.11-1951).

The new key is a gaging element called the Kodak Conju-Gage Worm Section, which superficially resembles a rack. Its simple form permits a precision of manufacture difficult to achieve with a circular master, especially in finer pitches.

A single Kodak Conju-Gage Worm Section of given normal pitch and pressure angle checks any corresponding spur or helical gear of any helix angle. Common toolroom procedures can verify its accuracy analytically and conclusively. And, unlike a circular master gear, it can be reground to original specifications and precision when your own checks indicate the necessity.

A booklet describing the Kodak Conju-Gage principle and the instruments embodying it is yours for the asking. Write Eastman Kodak Company, Industrial Optical Sales Division, Rochester 4, N. Y.

CONJU-GAGE INSTRUMENTATION

...a new way to check gear precision in action

To inspect all kinds of complex parts on a bright screen, Kodak also makes two highly versatile contour projectors.

Kodak

American Blower . . . a time-honored name in air handling

Phoenix, Ariz., has a conveniently located American Blower Office to provide you with data and equipment for air handling. You can reach American Blower in Phoenix by calling 8-2793. In other cities, consult your phone book.

CAPITOL COMFORT

All of us can feel a bit prouder now that our most famous of buildings, the U.S. Capitol, has been renovated. The job also included the power plant where modern new American Blower Mechanical Draft Fans replaced the obsolete equipment. High static efficiency, low RPM, low tip speed and low inlet velocity are but a few of the many reasons these fans enjoy such wide acceptance. Our conveniently located branch offices, staffed with competent engineers, will be glad to furnish you with specific data.

CLEAN AIR

Soap manufacturers strive continually to achieve high standards of purity in their products. But industrial dusts raise hob at various stages of processing. American Blower equipment has helped several soap companies overcome this problem. American Blower fans and air washers, for example, are highly effective. The fan supplies an ample supply of circulating air. The air washer cleanses, purifies and freshens the air while removing dust and water-soluble odors.

YARN ABOUT YARN

A textile manufacturer was continually changing pulleys or setting the machine rate on his ring-spinning frames to fit the material that worked at the lowest speed. He'd heard about American Blower Gyrol Fluid Drives and decided to try them. Results were amazing. Gyrol Fluid Drive permitted a higher output within safe limits of the material, allowed spinning frames to start gradually with less yarn breakage. For your business, wouldn't smooth power transmission and adjustable speed control be a distinct advantage?

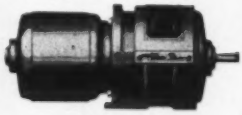
YOUR BUSINESS

If your needs call for heating, cooling, drying, air conditioning, or air handling equipment, you'll find American Blower an excellent source of supply. For data, phone our nearest branch office.

Unit Heaters

Mechanical Draft Fans

Air Conditioning Equipment



Gyrol Fluid Drives

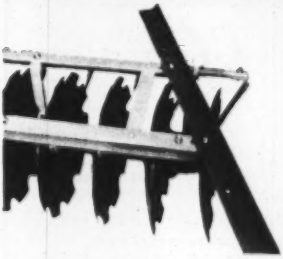
Utility Sets

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

YOUR BEST BUY **AMERICAN BLOWER** AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

VERSATILE NEW RODERICK LEAN MOBIL-DISC HARROW



Unusually flexible, rigid frames are fastened securely with Elastic Stop Nuts

Equipped throughout with vibration-proof, self-locking Elastic Stop nuts

A new, and completely re-designed wheel type disc harrow—the revolutionary Mobil-Disc, manufactured by Farm Tools, Inc., Mansfield, Ohio—owes many of its fundamental advantages to the positive, shock-proof locking of Elastic Stop Nuts.

Mobil-Disc frames are flexible enough to perform over the roughest contours, yet tough enough to insure uniform soil penetration. It is called the most shock-absorbent frame ever built—the result of a new design approach which eliminated the older welded construction. Field studies of welded joint construction revealed that fatigue frequently resulted in joint fractures; in other cases frames were permanently "set" or bent by service operating conditions. The new method of construction specifies alloy steel section members, bolted together for greater frame elasticity and strength. Grueling field tests proved that Elastic Stop Nuts provided the only bolting method that would withstand the work-load Mobil-Disc was engineered to take!

The 200-odd Elastic Stop Nuts on each Mobil-Disc perform a double function that no other type of fastener can duplicate. They must *stay on*, under the most extreme punishment. In addition, for the Mobil-Disc to perform properly, they must *hold together* the various functioning parts without any "give". This is basic in the design of the new machine—the flexible recovery of the frame depends upon complete tightness between bolted sections—and thorough tests have proven Elastic Stop Nuts' dependability.

POINTERS on how to get best results from Elastic Stop Nuts, with an explanation of how the famous Red Collar works, are yours for the asking. Just mail our coupon.

Elastic Stop Nut Corporation of America is also maker of the ROLLPIN

ROLLPIN TRADEMARK

Dept. N16-711, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, N. J.

Please send the following free information:

- ☐ Hints on use of Elastic Stop Nuts
- ☐ AN-ESNA Conversion Chart
- ☐ Elastic Stop Nut Bulletin
- ☐ Rollpin Bulletin

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PROTECT YOUR BEARINGS with KLOZURE* OIL SEALS!

There's a model designed for every bearing application

GENERAL PURPOSE

MODEL NO.		APPLICATION
63		Normal and high-speed service.
53		Normal and high-speed service.
51		Medium-speed rotary service, low pressure and reciprocating service.
64		Large shafts operating under severe service.
65		Heavy-duty service at moderate speeds.

SPECIAL PURPOSE

MODEL NO.		APPLICATION
54		Sealing spherical surface on self-aligning or spherical bearings.
142		Sealing plane surface perpendicular to axis of the shaft.
SPLIT KLOZURE		For installation without disassembly of equipment.
11		Medium-speed service against heavy lubricants and mild dust conditions.

DUAL TYPE

MODEL NO.		APPLICATION
R-1		Medium-speed double-duty service.
R-2		Medium-speed double-duty service where liquids are present on both sides of seal.
TF		Medium-speed service. Two sealing elements in tandem.
TB		Medium-speed service where abrasive conditions are severe.
T-2		Medium-speed service where minimum leakage is of great importance.
F-1		Medium-speed service where dirt conditions are severe.

METRIC SIZES

MODEL NO.	APPLICATION
63 - 53 51 - 65	For press fit into standard International millimeter ball and roller bearing housings.

TEMPERATURES ABOVE 300° F.

SPECIAL MODELS	APPLICATION
Klozures with Silicone sealing elements can be furnished in most Klozure Model numbers.	Excessive temperature service due to actual operating temperature or generated heat on very high-speed shafts.

FOR LIMITED SPACE

MODEL NO.		APPLICATION
71B		Normal and high-speed service where liquid lubricants are to be contained.
91B		Normal and high-speed service and to accommodate large housing bore variations.
71A		Springless Klozure where heavy lubricants are to be contained and dirt is to be excluded.
91A		Springless Klozure for low-speed service and to accommodate large housing bore variations.
71A7		Springless Klozure for low-speed service on tapered roller bearings requiring clearance for bearing cone.

EXTERNAL TYPE

MODEL NO.		APPLICATION
111		Medium-speed rotary service, low pressure and reciprocating service.
113		
123		Normal and high-speed service.

For detailed information write for Klozure Catalog No. 10.

*Registered Trademark

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.
In Canada: The Garlock Packing Co. of Canada Ltd., Toronto, Ont.

GARLOCK

PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS, RUBBER EXPANSION JOINTS

The direct-process prints and Blueprints received from vendors are reproduced on Autopositive Paper when extra copies are needed for the drafting room or shop. Deletions and additions can be made readily on Autopositive intermediates . . . saving drafting time.

Drawing Reproduction Revolutionized

with Kodagraph Autopositive Paper

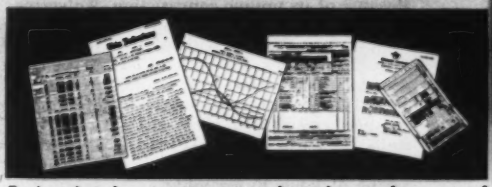
Here are some of the ways Sikorsky Aircraft, Div. of United Aircraft Corp., is using this photographic intermediate material.

There are no limitations now on the types of drawings, prints, or documents which can be reproduced in Sikorsky Aircraft's direct-process machine.

Translucent or opaque—it doesn't matter; even "two-sided" originals can be reproduced on *Kodagraph Autopositive Paper*. And each print is a sparkling intermediate—dense photographic black lines on durable, evenly translucent white paper —*ready* to produce as many direct-process prints as are needed.

How positive photographic intermediates are produced. Kodagraph Autopositive Paper is exposed in Sikorsky's direct-process machine . . . processed in standard photographic solutions. No negative step . . . no darkroom handling—*a revolutionary, economical operation that speeds print service to all departments.*

Six copies are needed of each oscillograph record obtained while flight-testing Sikorsky helicopters. Autopositive intermediates —which hold the faintest line—are made . . . and used to produce direct-process prints which are sharp and legible in every detail.



Engineering department reports, charts, letters—documents of every type—are reproduced on Autopositive Paper so that the required number of direct-process prints can be made. A local blueprinter handles the "overflow" demand for Autopositive copies.

Learn how Kodagraph Autopositive Paper is simplifying routines in thousands of concerns. Write today for a free copy of "New Short Cuts and Savings" for interesting facts about companies you know . . . and a revolutionary new product *you should know.*

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

MAIL COUPON FOR FREE BOOKLET

EASTMAN KODAK COMPANY
Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a free copy of your new illustrated booklet, "New Short Cuts and Savings."

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Company _____

Street _____

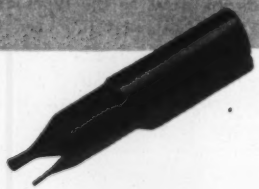
City _____ Zone _____ State _____

16

Kodak
TRADE-MARK

2 WOLVERINE DEVELOPMENTS THAT SHOULD COMMAND YOUR IMMEDIATE INTEREST

These developments are only two of the many that Wolverine offers. They represent new opportunities for designing tubular parts which will require the use of less material, and will improve production efficiencies. They are important contributions to the defense program and help to utilize the available copper to the best advantage.



WOLVERINE TRUFIN*

Because of its unique construction, Wolverine Trufin* will withstand vibration and sudden temperature changes without impairing heat transfer qualities. The ratio of outside surface area to inside surface area is often as high as 19 to 1. Such high ratios permit smaller, more compact and usually more efficient operating units, which in turn makes for fewer components and less material, as well as substantial saving of labor in assembly.

*Reg. U. S. Pat. Off.

SPUN END PROCESS*†

is a fast, economical and efficient method of forming the end of tubular parts. It has, in many cases, supplanted other methods of fabrication. The spun end process can produce a wide variety of end forms ranging from long shapes to sharply turned ends—with or without apertures.

This process brings you lower costs in construction and assembly which is of such vital interest to all industry.

*† A Patented process RE 22465

Send for more detailed information about these Wolverine tube developments.

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ont.

WOLVERINE TUBE DIVISION

Calumet & Hecla Consolidated Copper Company
INCORPORATED

Manufacturers of seamless, nonferrous tubing

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Sales Offices in Principal Cities

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An Open Letter to EXPERIENCED ENGINEERS

To Aeronautical, Electrical and Mechanical Engineers:

Today more than ever Engineers find themselves in the fortunate position of having the choice of many jobs with good pay, excellent future and on-the-job benefits. It becomes, then, a choice of surroundings, locality, living conditions, leisure time pleasures, and proper advantages for the family.

LOCKHEED'S Georgia Division, located at Marietta, only 8 miles from Atlanta, offers unequalled off-the-job benefits. Atlanta and North Georgia are famous for their healthful climate and outdoor sports. Atlanta is the second highest large city in the United States. Its 88 parks cover 1600 acres, and its 22 excellent golf courses offer year-round enjoyment.

The section is also famous for beautiful homes and gracious Southern living. Desirable, modern housing is available to the LOCKHEED Engineer and his family. Fine elementary and high schools, colleges and universities, plus vocational and professional schools, serve the area. 10 radio and 3 television stations and more than 50 theatres bring in top entertainment. Best cultural advantages are offered, and 500 churches are affiliated with 40 creeds and denominations.

Yes—YOUR EXPERIENCE can bring you a job with a new division of a top leader in commercial and military aviation, PLUS a BETTER life, a BETTER future, off the job and on.

(If you prefer the West Coast, your application will be promptly forwarded to LOCKHEED at Burbank, Calif., where similar opportunities are available.)

CLIP AND MAIL TODAY!

Lockheed Employment Manager
594½ Peachtree St., N.E.
Atlanta, Ga.

Please send full details on MY opportunity at LOCKHEED

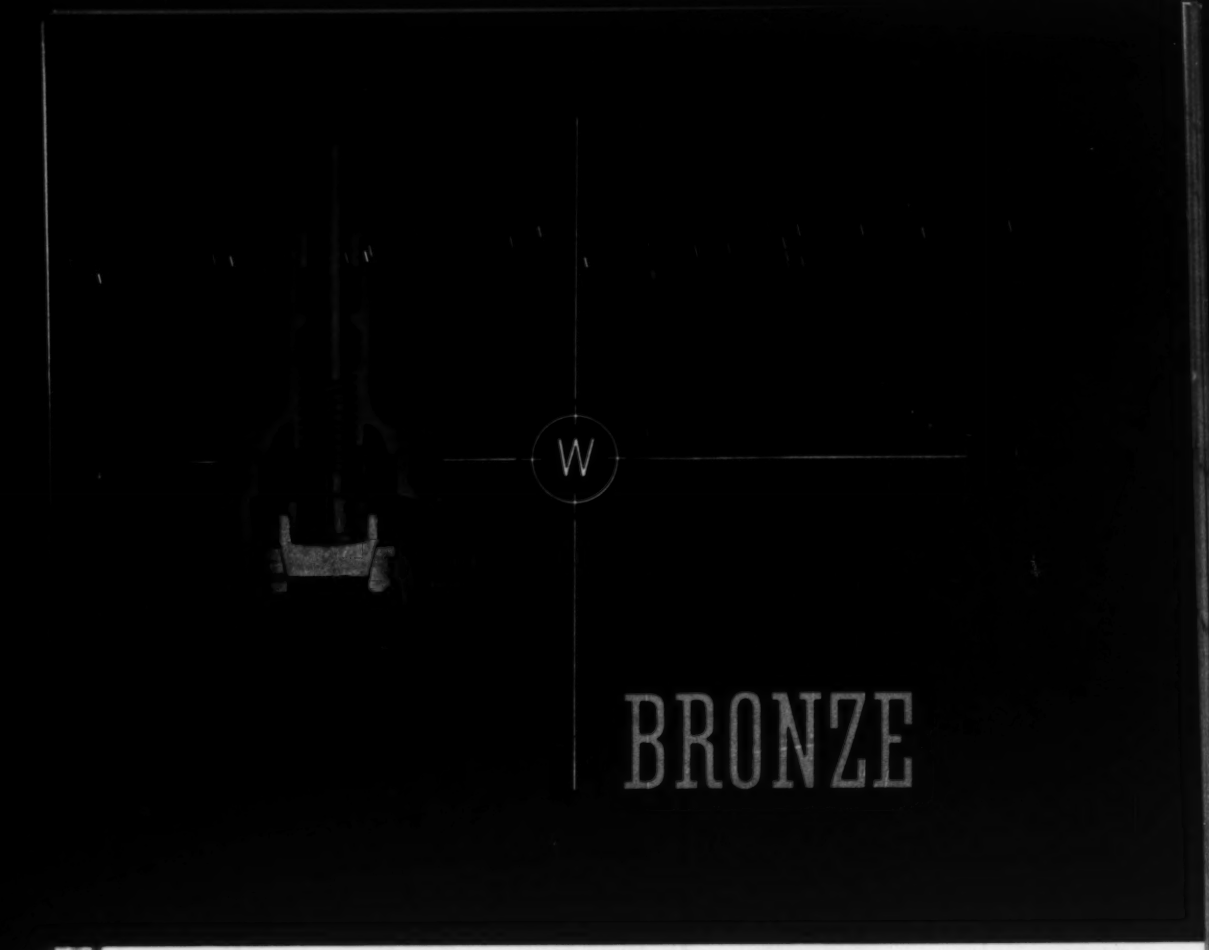
Name

Address

City and State

Job Interested In

LOCKHEED
AIRCRAFT CORPORATION

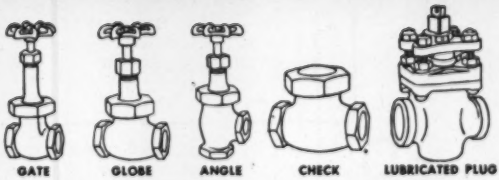


COMPLETE LINES OF BRONZE VALVES AND PIPE FITTINGS are manufactured by Walworth in a variety of types, pressure ratings, sizes, and patterns, including Walseal® Bronze Valves and Fittings for making Silbraz® joints.

Walworth also manufactures complete lines of valves and fittings – including Lubricated Plug Valves – made of steel, iron, and special alloys as well as bronze.

Walworth-made valves, pipe fittings, and pipe wrenches, total approximately 50,000 items–all sold through distributors in principal centers throughout the world.

Let Walworth engineers help you with your problems. For full information call your local distributor, nearest Walworth sales office, or write to Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.



Bronze valves in gate, globe, angle, check, and lubricated plug types are manufactured by Walworth. Illustrated is a sectional view of a Walworth No. 225P Bronze Globe Valve. This valve has a working steam pressure rating of 350 psi at 550F (1,000 psi non-shock cold water, oil, and gas pressure). It features a renewable, plug type, stainless steel seat and disc, heat treated to 500 Brinell hardness.

WALWORTH

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

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IF YOU USE ALLOY PIPING...

ALLOY STEEL WELDING FITTINGS
Key-Kast
LONGER LIFE FOR PIPING SYSTEMS
Key Company
EAST ST. LOUIS, ILLINOIS
PIONEERS IN DEVELOPING AND MANUFACTURING PRODUCTS FOR HIGH TEMPERATURES AND PRESSURES

This New Bulletin Will Show You How KEY-KAST ALLOY WELDING FITTINGS Can Add Longer Life to Your Alloy Piping System—at Lower Cost. Send for Your Copy Today!

KEY-KAST ALLOY WELDING FITTINGS OFFER *ALL* THESE ADVANTAGES TO YOUR PIPING SYSTEM:

- Greater wall thickness throughout—for increased structural strength.
- Extra thickness in critical areas—for greater allowance against corrosion and erosion.
- Lower unit cost.
- Meets A.S.M.E., A.S.T.M., and A.S.A. codes.
- Bosses provided on all fittings for tapped openings.
- Controlled quality... through rigid metallurgical control—produced, inspected and tested in one plant.

AVAILABLE IN ALL SHAPES... SIZES... SCHEDULES... IN LOW AND INTERMEDIATE ALLOYS AND VARIOUS STAINLESS STEELS

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Since 1916... manufacturers and developers of products for high temperatures and pressure.

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P. O. Box 494-f East St. Louis, Illinois
Please send me your new Key-Kast Alloy Welding Fitting Bulletin.
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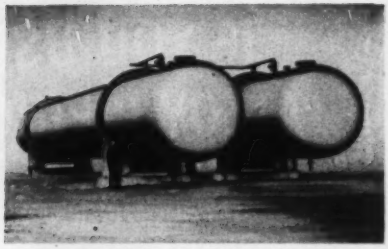
100,000 GALLONS OF SAFETY



Posey Iron Works twin-tank installation for prominent public utility.

72" diameter headers for water intake lines fabricated throughout in our shops.

Alloy Steel Pipe awaiting shipment from the Posey Iron Works.

The Posey Iron tank illustrated provides 100,000 gallons of *safe* storage because forty-two years of experience went into its fabrication. And the real safety factor in any tank is the sum of its maker's experience . . . skill . . . facilities . . . and shop practices.

Here are a few of the advantages offered tank users by Posey Iron's knowledge . . . know-how . . . modernized plant . . . and sound practices:

1. Correct size and type of tank is determined by consultation with Posey Iron executives.
2. Posey Iron has the facilities to solve problems of *specialized* fabrication . . . design . . . or maintenance.
3. Posey Iron can help you determine the correct alloys when corrosive materials must be handled.

Talk over your steel plate requirements with the Posey Iron Works — where there is forty-two years of sound experience at your service.

- **Tanks**
- **Stacks**
- **Digesters**
- **Pipe**
- **Pressure Vessels**
- **General Steel Plate Construction**

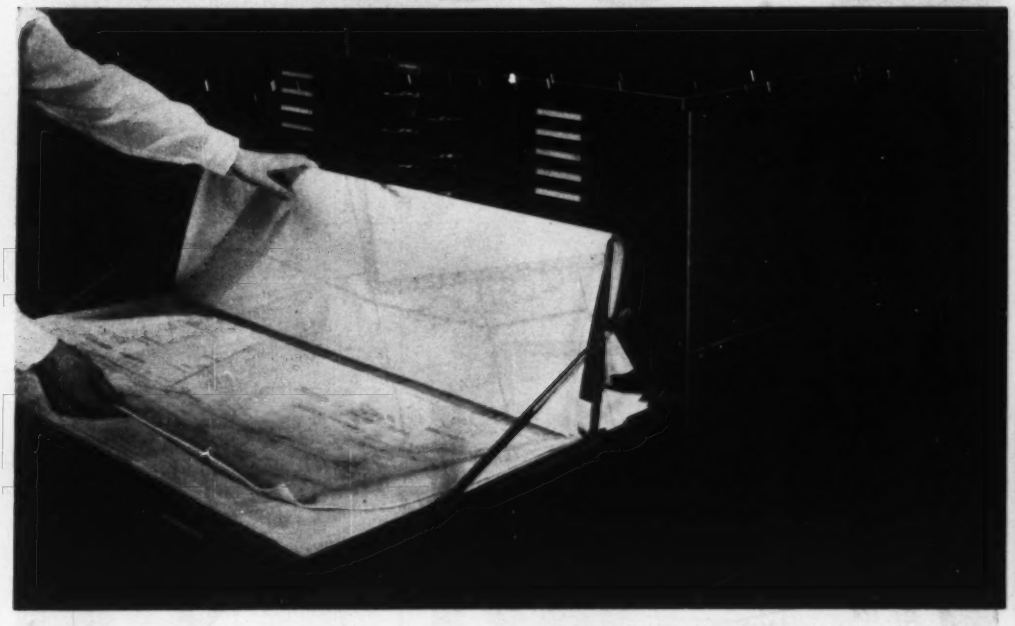
Established Since 1910 — New York Office: Graybar Bldg.

POSEY IRON WORKS, INC.

LANCASTER, PENNSYLVANIA

DIVISIONS: BRICK MACHINERY, FOUNDRY, INDUSTRIAL HEATING, IROQUOIS, SHIPBUILDING, STEEL PLATE

Are you using this *Safe Simple Speedy* filing equipment?



This is a Hamilton Shallow-Drawer Unit, which gives you greater drawing-protection and speedier, easier access than any filing equipment you can buy.

The exclusive Hamilton Tracing Lifter shown in action above is the major reason. Here's what this does for you—

first, it *RAISES* and *HOLDS* sheets filed above the one you want

second, it *LIFTS* and *SUPPORTS* these sheets while you safely remove or replace a drawing

third, it *COMPRESSES* all sheets when drawer is closed—keeps them perfectly flat and wrinkle-free

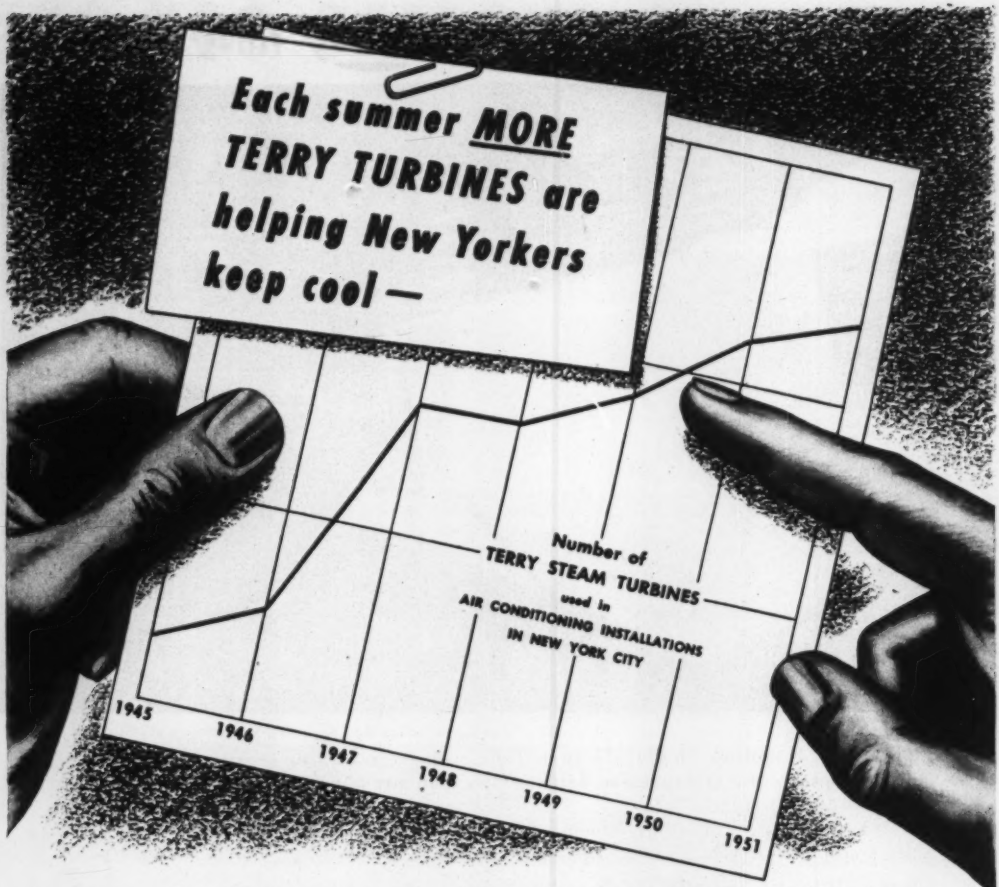
Can you improve your filing system with this *safe, simple, speedy* equipment? Yes . . . and at a surprisingly modest cost. Ask your Hamilton Representative to prove this, or write Hamilton now for complete specifications.

Want more details on Hamilton Shallow-Drawer Units? Write today to Drafting Equipment Division, Hamilton Manufacturing Company, Two Rivers, Wisconsin.

HAMILTON WORK-DESIGNED DRAFTING EQUIPMENT

Hamilton Manufacturing Company

TWO RIVERS, WISCONSIN



In recent years, New York City has witnessed a rapid gain in the number of air-conditioning installations providing comfort cooling by means of steam. And, as the accompanying chart shows, TERRY STEAM TURBINES have figured prominently in this relatively recent development.

TERRY TURBINES make an ideal prime mover for driving the refrigerating compressor. They respond automatically to the temperature requirements, and will cut back to as little as 15 percent of rating without attention. A Terry-designed unit assures economy and ease of operation.

Before you make a decision on your air-conditioning installation, why not call in a Terry representative? He will be glad to explain the benefits of *comfort cooling by steam.*

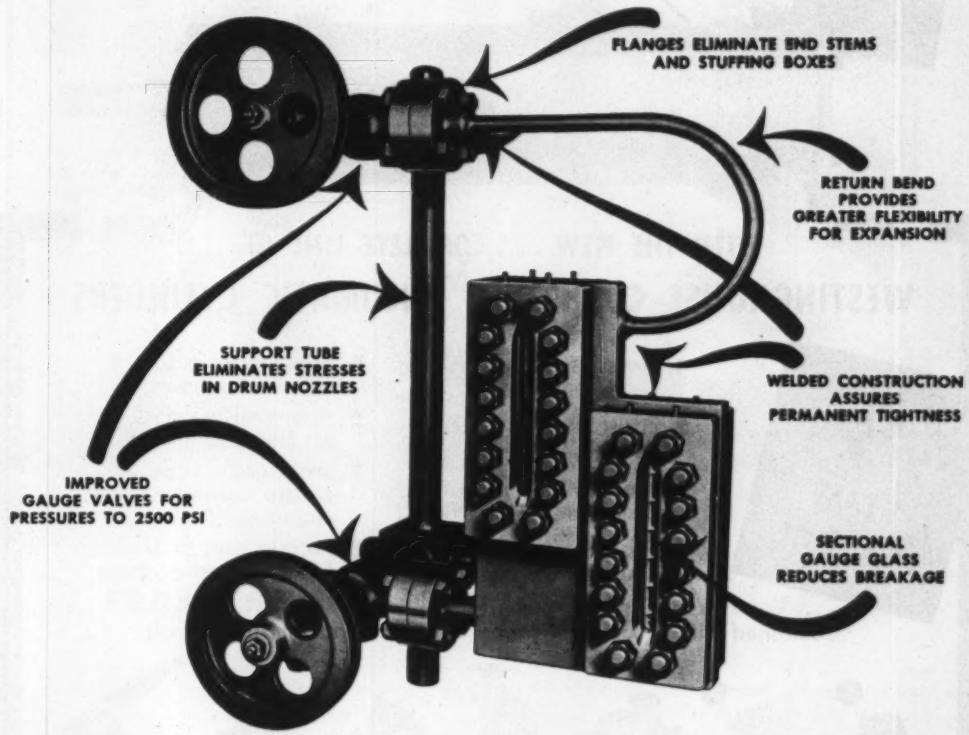
PARTIAL LIST OF TERRY TURBINE INSTALLATIONS IN NEW YORK CITY
Best & Co. • Bloomingdale Bros. • Book-of-the-Month Club
Carbide & Carbon Building • Federal Reserve Bank • Lord & Taylor • Macy's New York • Madison Square Garden
James McCreery & Co. • Mutual Life Insurance • Port Authority Bus Terminal • The 260 Madison Avenue Building

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1192

New DIAMOND Flange Connected WATER GAUGES

More Suitable to High Pressure Operation


FLANGES ELIMINATE END STEMS AND STUFFING BOXES
RETURN BEND PROVIDES GREATER FLEXIBILITY FOR EXPANSION
SUPPORT TUBE ELIMINATES STRESSES IN DRUM NOZZLES
WELDED CONSTRUCTION ASSURES PERMANENT TIGHTNESS
IMPROVED GAUGE VALVES FOR PRESSURES TO 2500 PSI
SECTIONAL GAUGE GLASS REDUCES BREAKAGE

In addition to the advantages shown above, this gauge provides maximum level visibility with minimum drum nozzle spacing. Greater reading accuracy is another important feature. The bend (which is uninsulated) provides sufficient condensing area to assure active circulation of hot condensate through the gauge. This maintains the gauge at higher temperature so there is less difference between boiler water and gauge water density. That and the shorter gauge assure greater accuracy.

Write for new Bulletin No. 1051 describing Diamond Water Gauges and Water Columns.

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

Diamond Specialty Limited—Windsor, Ontario

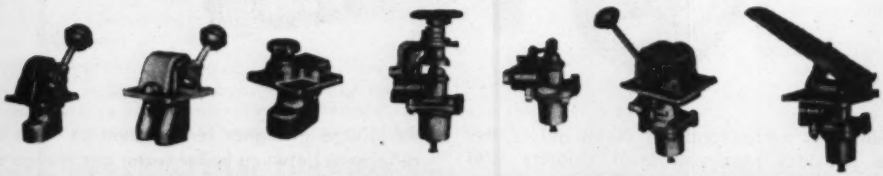
4860

PRODUCTIVITY UP ...COSTS–DOWN

WITH THE NEW . . . COMPLETE LINE OF WESTINGHOUSE CUSHIONED PNEUMATIC CYLINDERS

1. DIAMETERS: 1½" to 8" . . . required stroke
2. CUSHIONED ADJUSTABLE STROKE
3. FLANGE, FOOT, SWIVEL, OR TRUNNION MOUNTING
4. PRESSURE TYPE END SEALS AGAINST LEAKAGE
5. ROTATING HEADS for EASY INSTALLATION
6. SOLID CONSTRUCTION— NO STAY BOLT STRETCH
7. STOCK HEADS, RODS AND BARRELS ASSEMBLE TO MEET REQUIREMENTS
8. PACKING CUPS OF FAMOUS "WABCO"® COMPOSITION

Combined with a complete range of modern pneumatic controls



INDUSTRIAL PRODUCTS DIVISION

WESTINGHOUSE AIR BRAKE COMPANY WILMERDING, PENNA.

Factory Branch: EMERYVILLE, CALIF. Distributors throughout the United States . . . Consult your Classified Directory. Distributed in Canada by: Canadian Westinghouse Co., Ltd., Hamilton, Ontario.

V-1869

FROM THE SMALLEST *TO THE* LARGEST—

Yes, anything you can want in a pressure gauge is at your beck and call in the great line of instruments bearing the most respected name in gauges... MARSH!

Not just any size, but any duty, any case style, any finish, any dial graduations, any mounting. So complete is the line, that gauges which are "special" to other manufacturers, are often standard to Marsh—an important reason for the plus value you get in Marsh instruments.

You may merely need a gauge for ordinary service. Or you may need a gauge that will stand up under tough conditions such as extreme pressure, extreme temperature, corrosion, vibration, pulsation. But whatever the service you have only to select the Marsh Gauge recommended for the specific condition to find the final answer to your instrument problem.

Ask for catalog **covering Marsh products which include: A full line and range of gauges in pressure, compound, altitude, hydraulic, sprinkler, ammonia, ounce-graduated retard, test, and diaphragm types. Dial thermometers in rigid stem and remote reading types. A broad line of steam heating and refrigeration specialties including the Electrimatic line of refrigeration water regulators and solenoid valves.**

MARSH INSTRUMENT COMPANY
Sales affiliate of JAS. P. MARSH CORPORATION, **Dept. 29, Skokie, Ill.**
Export Dept.: 155 E. 44th St., New York

Marsh alone has the RECALIBRATOR **—quickest and best way to correct a gauge or dial thermometer that has been knocked out of adjustment.**

MARSH GAUGES

24 ACRES *Cover the World*

. . . with TOP QUALITY

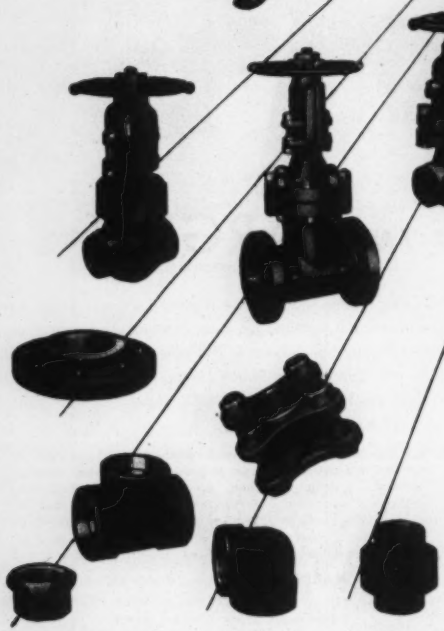
DROP FORGED STEEL

VALVES, FITTINGS and FLANGES

by

Vogt

Air View of Henry Vogt Machine Co.



This 24 acre Vogt plant supplies the most comprehensive line of top quality *drop forged* steel piping materials anywhere available to industry. That's why they're the choice of leading refineries, power plants, chemical plants, etc., the world around!

OUR COMPLETE LINE INCLUDES

Flanged, Screwed and Socket Weld End Globe, Gate and Check Valves • Ells, Tees and Crosses • Couplings • Bushings • Plugs • Unions • Flanges and Flange Unions • Welding Heads

HENRY VOGT MACHINE CO. LOUISVILLE 10, KY.

Branch Offices: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

Hachmeister-Inc. Reveals Benefits Obtained By SK Steam Jacketed Pump's Performance

("On-The-Job" Illustration and Story by Courtesy of Hachmeister-Inc. of Pittsburgh, Pa., makers of Hako Products)

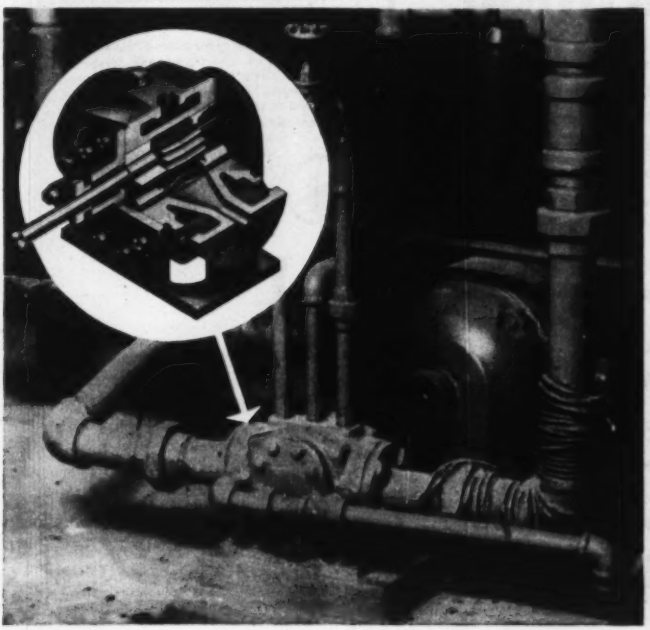
"SK Steam Jacketed Pumps have proved very advantageous for us," states Mr. H. J. Snyder, Plant Engineer, Hachmeister-Inc., and tells why as follows:

"We have benefitted in our operations because: First, the steam jacket eliminates the need for outside heating necessitated by the viscosity of our material; second, they pump a wide range of thick and thin liquids equally as well; third, they have greatly increased our capacities; and fourth, absolutely no maintenance has been required since installation."

Three years ago, Hachmeister-Inc. installed the SK Steam Jacketed Gear Pump illustrated for use in connection with the manufacture of Hako-Short.

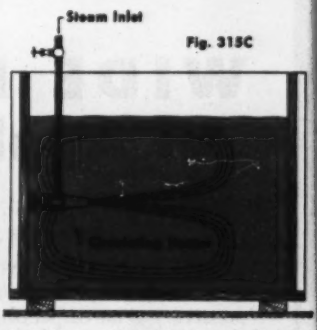
Since then, the pump has been used to distribute various fats and oils from storage to mixing and blending kettles. It is gravity fed from three 300 gal. stainless steel kettles and pumps the material a vertical distance of 10 ft. and a horizontal distance of 42 ft. to supply three other 300 gal. mixing kettles. Using 2" ID inlet and discharge pipes, the pump handles approximately 15 gpm of material.

If you are handling or are planning to handle liquids with viscosities which necessitate the use of high temperatures, investigate this pump. Details are available on request.



SIMPLE JET HEATER HEATS AND CIRCULATES LIQUIDS IN TANKS

SK Fig. 315 Circulating Heaters operate on jet principle to heat and circulate liquids in open tanks. Steam enters heater through inlet at top of heater and issues through a double steam nozzle in the form of two jets — one an annular suction jet and the other a straight forcing jet. The entrainment action of the suction jet draws tank



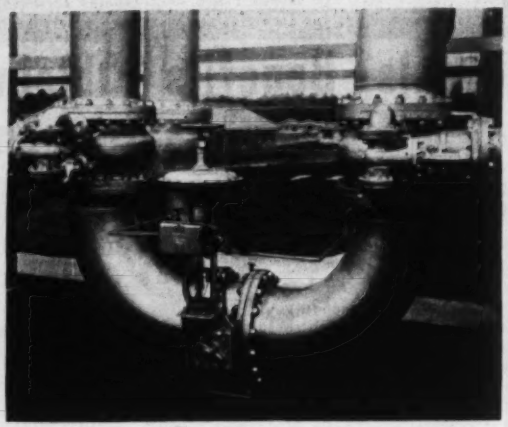
liquid into mixing nozzle and discharge tube where it is heated by the steam. The forcing action of the central steam jet discharges liquid from heater and causes continuous circulation within tank.

These heaters offer several outstanding advantages which are explained in detail in Bulletin 3-A. Ask for a copy.

Manufacturing Engineers

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



▲ R-S Automatic Valve installed on water jacket to gas engine in gas booster station.

WIDE RANGE of Application

R-S Valves are used in air, gas, liquid, steam, and semi-solid service for the shut-off and regulation of volume and pressure, pressure relief, liquid level control, back pressure, water hammer, steam hammer, constant differential pressure, and the output control of pumps, fans, engines and turbines. Suitable for service in the temperature range from minus 300° to plus 2000° F. 2 to 2500 psig.

Simplicity of design, ease of operation, positive rubber seat shut-off, and the wide range of application indicate the high order of metallurgical and mechanical engineering that is embodied in every R-S valve.

Consult your local R-S Valve Engineers, or write direct.

R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.
An S. Morgan Smith Company Subsidiary
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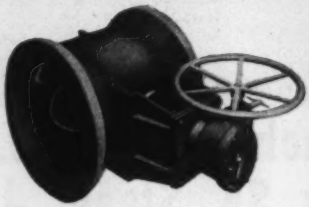
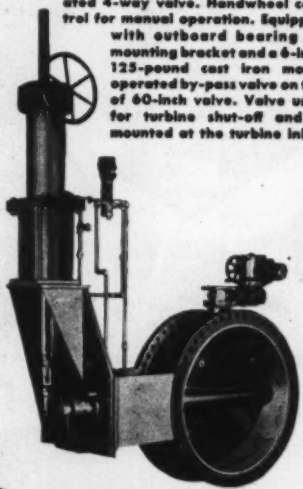


No. 836—24-inch 125-pound cast iron hub-end valve with bronze liner and monel periphery on vane for water service. Equipped with totally enclosed gear reducer, handwheel and locking device.

No. 801—3-inch 125-pound bronze screwed-end valve with handlever control and locking device.

No. 828—60-inch 150-pound cast steel valve with 18-8 shafts, bronze bushings and bronze body liner. Cylinder operator is controlled by electric motor operated 4-way valve. Handwheel control for manual operation. Equipped with outboard bearing on mounting bracket and a 6-inch 125-pound cast iron motor operated by-pass valve on top of 60-inch valve. Valve used for turbine shut-off and is mounted at the turbine inlet.

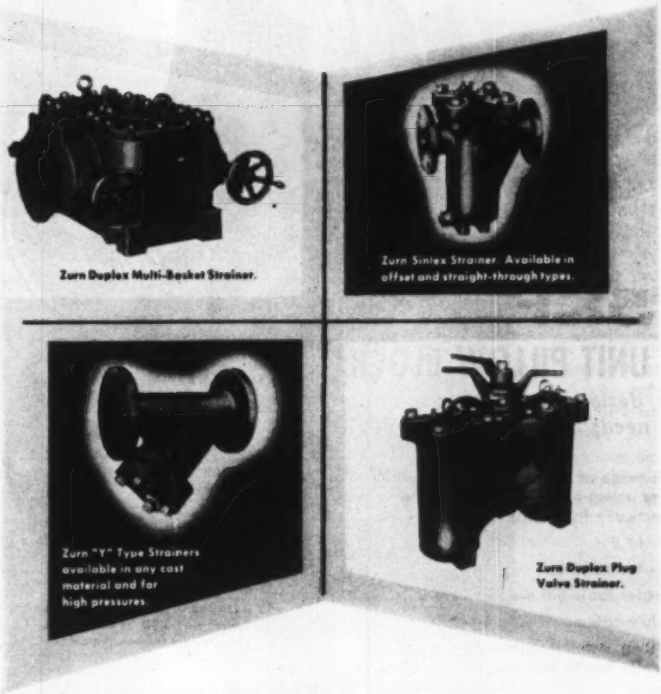


ZURN

OUR 50th ANNIVERSARY

STRAINERS IMMEASURABLY IMPROVE THE HANDLING OF FLUIDS (WATER, OIL, CHEMICALS) THROUGH PIPE LINES

These Strainers Permit HIGH *Rates of Flow* With Remarkably LOW *Pressure Drop* From Input to Output



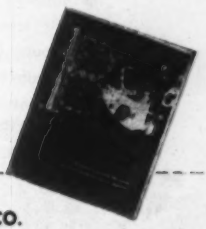
Zurn Duplex Multi-Basket Strainer.

Zurn Sinlex Strainer. Available in offset and straight-through types.

Zurn "Y" Type Strainers available in any cast material and for high pressures.

Zurn Duplex Plug Valve Strainer.

Write for Pipe Line Strainer Manual No. 951, including previously unpublished pressure drop data.



Zurn Strainer applications include Municipal Water Systems, Process Industries, Ships, Power Stations, Industrial Plants and High Temperature Installations. Zurn Engineers are available for consultation on all fluid handling problems.

J. A. ZURN MFG. CO.

INDUSTRIAL DIVISION • ERIE, PA., U. S. A.

***In Canada:* Canadian Zurn Engineering Ltd., Montreal, P. Q.**

J. A. ZURN MFG. CO.
Industrial Division; Erie, Pa., U. S. A.
Please send me Pipe Line Strainer Manual No. 951

Name_____

Position_____

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NEW

NEW from SKF

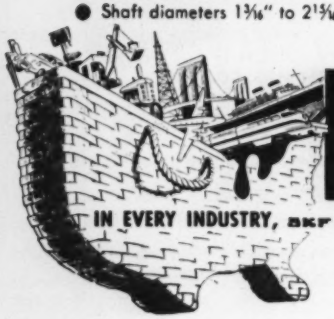
the HESS-BRIGHT "SY" UNIT PILLOW BLOCK

A new Unit Pillow Block, designed by SKF to meet tomorrow's needs of modern industry.

Here are the design features:

- SKF Red Seal, made of DuPont Fairprene, retains lubricant. Wiping action of the seal against the inner ring is practically frictionless.
- Rotating flingers exclude dirt.
- Set screws for ease of installation.
- Spherical outer ring compensates for initial misalignment.
- Alemite fitting for re-lubrication.
- Interchangeability with existing installations made possible by bolt hole spacing and center height features.
- Shaft diameters 1 3/16" to 2 15/16".

Detailed illustration of rotating flinger and RED SEAL—the extremely light tension contact seal.



SKF
BALL AND ROLLER BEARINGS

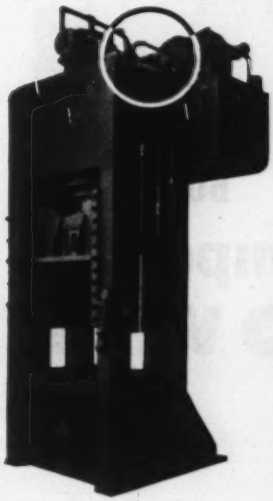
IN EVERY INDUSTRY, SKF Puts The Right Bearing In The Right Place

From now on, the name to remember in Unit Pillow Blocks is HESS-BRIGHT "SY"—manufactured in our plants, to the same high quality standards as all SKF products. Ask your SKF Distributor to show you the HESS-BRIGHT "SY"; or write SKF direct for complete information on this *newest* Unit Pillow Block.

SKF INDUSTRIES, INC., Phila. 32, Pa.—*manufacturers of* **SKF** *and* HESS-BRIGHT *bearings.* 7123-A

compactness

...a big factor in Clearing's selection of Ross Exchangers



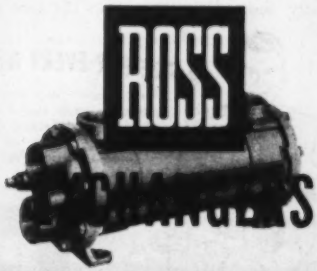
Compactness that lends itself to a neat installation with the hydraulic unit . . . that's a big factor in the selection of Ross Type BCF Exchangers for Clearing Hydraulic Presses.

Whether it's a 150-ton or a 2200-ton press (like those illustrated), the Clearing Machine Corporation can thus furnish *dependable protection* of the hydraulic oil temperature with a minimum of installation time and within a minimum space.

Today, manufacturers of *all* types of hydraulic machines and equipment are profiting from the singular advantages of Ross Type BCF Exchangers. Performance proved, built from durable copper and copper alloy materials throughout, they can be depended upon for long, hard service. Pre-engineered and completely standardized, they are available from stock.

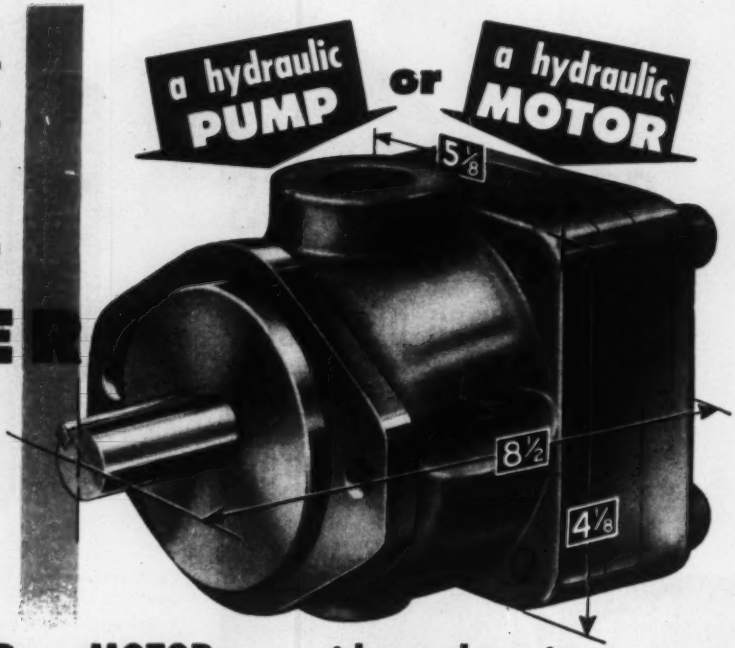
For details, request Bulletin 1.1K5.

ROSS HEATER & MFG. CO., INC., Division of American Radiator & Standard Sanitary Corp., 1448 West Avenue, Buffalo 13, N. Y. In Canada, Horton Steel Works, Limited, Fort Erie, Ont.



Serving home and industry

Your best buy in compact POWER



Ready for either PUMP or MOTOR use without alterations

Denison's new simplified vane-type power units offer *interchangeable* pump and fluid motor utility in the most compact design ever offered for hard, continuous duty at 2000 psi. The Pump/Motor shown above — only 8½" long — is available in models that pump from 2.7 to 7.5 gpm at 2000 psi.

Three other sizes offer a choice of models with pumping capacities up to 70 gpm at 2000 psi.

As motors, the four sizes offer high torque ratings from 13 to 257 pound-inches per 100 psi.

Check the added features of these versatile Denison Pump/Motors — then write for full information.

Hydraulically Balanced Vanes. Rugged specially designed vanes contact the cam ring with dual sealing edges. Complete hydraulic balance assures minimum wear on both vanes and cam ring.

No Pulsation. Smooth, hydraulically balanced action brings uniform delivery that reduces surge and pulsation to a minimum.

Interchangeable cam rings for each Pump/Motor size widens the range of capacities for both pump and motor applications.

Convertible. Full radial balance makes each Pump/Motor adaptable to either pump or fluid motor needs *without alterations of any kind* — for continuous duty at 2000 psi.

Bi-directional Rotation. All Pump/Motor sizes and models are readily adjustable for either clockwise or counterclockwise operation.

"A SIZE FOR EVERY NEED"

Four Sizes—plus interchangeable cam rings in each size — provides pumps of sixteen different displacement ratings — or motors of eleven different torque capacities. Write today for full details on Denison Pump/Motors — your biggest buy in versatile, compact power!

The **DENISON** Engineering Co.,
1189 Dublin Road, Columbus 16, Ohio

DENISON Hydr**OIL**ics

PUMP/MOTOR

"The Finest Money Can Buy!"

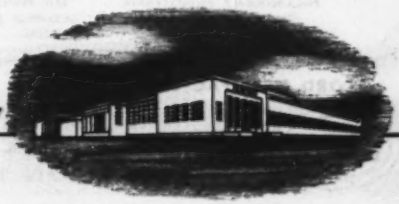
LEADING THE WAY THE YEAR 'ROUND

BUSH . . . THE YEAR 'ROUND LINE

Autumn, winter, spring and summer, there's a Bush unit to handle the heating or cooling requirements for product or comfort. Air Handling units and Comfort Conditioners to take the "dog" out of the summer days; Unit Coolers and Product Coolers, Evaporative Condensers and Cooling Towers for year 'round use; water and steam coils, convectors, finned pipe radiation and baseboard convectors offer a fall and winter line for industrial and domestic heating; condensers, special coils and other heat transfer products all combine to offer the smart businessman a year 'round profit line.

Investigate this opportunity now by contacting the nearest Bush Representative or write the factory direct.

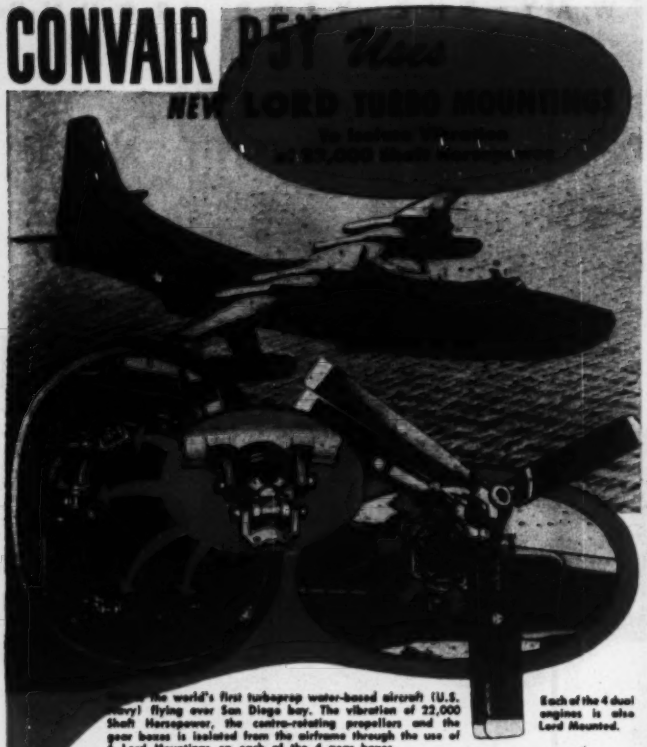
Complete catalogs containing valuable engineering data and specifications available upon request.



Bush Manufacturing Company

WEST HARTFORD 10, CONNECTICUT

CONVAIR P5Y Uses NEW LORD TURBO MOUNTINGS



...the world's first turboprop water-based aircraft (U.S. Navy) flying over San Diego bay. The vibration of 22,000 Shaft Horsepower, the contra-rotating propellers and the gear boxes is isolated from the airframe through the use of 6 Lord Mountings on each of the 4 gear boxes.

Each of the 4 dual engines is also Lord Mounted.

The Navy's new P5Y water-based aircraft is used for long range search-rescue and anti-submarine patrol missions. The world's first turboprop water-based aircraft is equipped with the world's first Lord turbo power plant mounting . . . a typical example of the manner in which Lord experience and research serves manufacturers of aircraft. Lord Engineering capabilities team up with precision manufacture to protect aircraft, to lengthen engine life, to increase crew comfort and alertness by isolating destructive vibration and shock. Regardless of the industry in which you are battling with vibration and shock, it will pay you to call in Lord Engineers.

FIELD ENGINEERING OFFICES—

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LORD MANUFACTURING COMPANY • ERIE, PA.

LORD — HEADQUARTERS FOR VIBRATION CONTROL

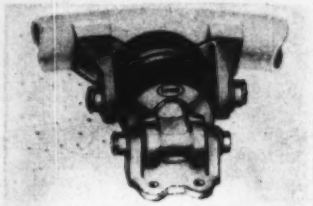
Lord Engineering Design Solves Unique Dual Vibration Problem in Mounting 22,000 Horsepower

Two distinct vibration isolation problems were present in mounting the 4 Allison remote-coupled T40 Turboprop Power Plants used in the Convair P5Y.

First, the vibration set up by the 14,300 r.p.m. of the turbine engine required a mounting system which would isolate first order engine disturbances. This was done using a stable mounting system with relatively small deflections for the power section alone.

Second, the operation of the propeller at 870 r.p.m. required a relatively soft, large deflection, mounting system for proper isolation of the remote gear box. However, the permissable misalignment of the flexible shafting from the power section to the gear box restricted mounting motions to narrow limits.

The problem was solved by using a soft, Lord Dynafocal type mounting system in conjunction with a torque restraining device. The mounting system provides good isolation in the vertical, lateral, pitch and yaw modes. In the roll direction, the torque restrainer holds the gear box from moving under torque loads. Thus critical vibration is isolated and gear box motions held within tolerance.



In addition, the mounting system provides positive snubbing, preventing the gear box from deflecting beyond the shaft input misalignment limits under transient overloads.

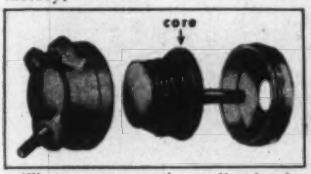
Thus, in brief, the analysis and subsequent attack of this unusual dual vibration problem by Lord Engineers provided the required isolation where extremes of vibration frequency and motion were encountered.

Further details on this and other difficult vibration isolation problems are available to those who write to Lord Manufacturing Company, Erie, Pa.

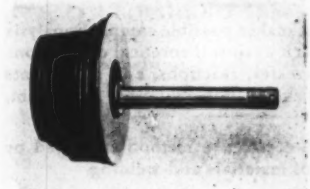
Lord Core Renewal Service Reduces Engine Maintenance Costs

Consistent with good airline maintenance practice, the Lord Manufacturing Company, Erie, Pa. has instituted a core renewal service on Lord Dynafocal Suspensions which is effecting material savings for airlines.

This service enables airline maintenance men to remove used cores from engine mountings, replace them with the stocked spares and return the old cores to the Lord factory.



The cores are immediately inspected, classified and checked by the Lord inspection department where the old rubber is removed and the metal is thoroughly cleaned. The metal parts are carefully inspected a second time to be sure they are in perfect condition. Then new rubber is bonded to the metal parts, resulting in the equivalent of brand new cores. They are then returned to the airline maintenance depot for replacement stock.



The result of this Lord service is a material saving in parts and in replacement time. Stocking sufficient numbers of spare cores promotes prompt replacement when required —but renewal of rubber in old cores saves sizeable amounts on the overall maintenance budget.

The Airlines welcome this field proved procedure of renewing cores. Old parts are returned and credit applied to the cost of the rebonded core, thus substantially lowering mounting maintenance costs.

Further details are available to interested airlines by writing Lord Manufacturing Company, Erie, Pa.

Lord Vibration Control Mountings are increasing payloads, protecting airframes, instruments and accessory equipment . . . adding to the comfort of passengers on 44 of the World's Leading Airlines. Why? Because Lord Engineering experience and manufacturing capabilities are providing light weight, low-cost mountings which contribute much to profitable airline operation. Lord engineering capabilities are being used to advantage by design engineers throughout world industry in their battle to isolate vibration and shock in a wide diversity of machines. Consult with Lord Engineers even before design takes shape on the board . . . and in perfecting machines already operating . . . You will profit.

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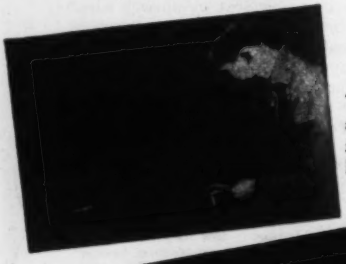
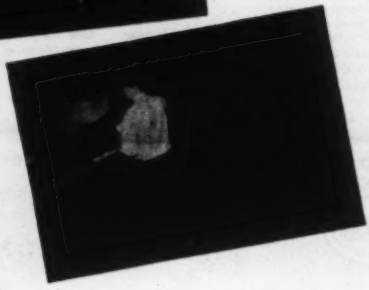
LORD MANUFACTURING COMPANY • ERIE, PA.

LORD — Bonded Rubber — HEADQUARTERS FOR VIBRATION CONTROL

WHERE KNOWLEDGE IS POWER





Knowledge is POWER when it is put to practical use. Here are examples:

- Intensive investigation by P.P.&E. into graphitization of steel piping resulted in the development of materials and methods that inhibit this cause of power piping failure.
- Model testing, as applied by P.P.&E., makes possible complete analysis of a complex piping system as a check against theoretical calculations — thus helps to avoid excessive stresses, reactions, and movements in the final system which could damage anchors and other equipment, and affect joints.
- Ultra-sonic testing — a unique non-destructive method employed by P.P.&E. — assures quality control of materials and welding.

This type of knowledge — plus the practical experience P.P.&E. has acquired during fifty years of specialization IS power — because it results in greater safety, higher efficiency, and longer life from high-temperature, high-pressure piping.

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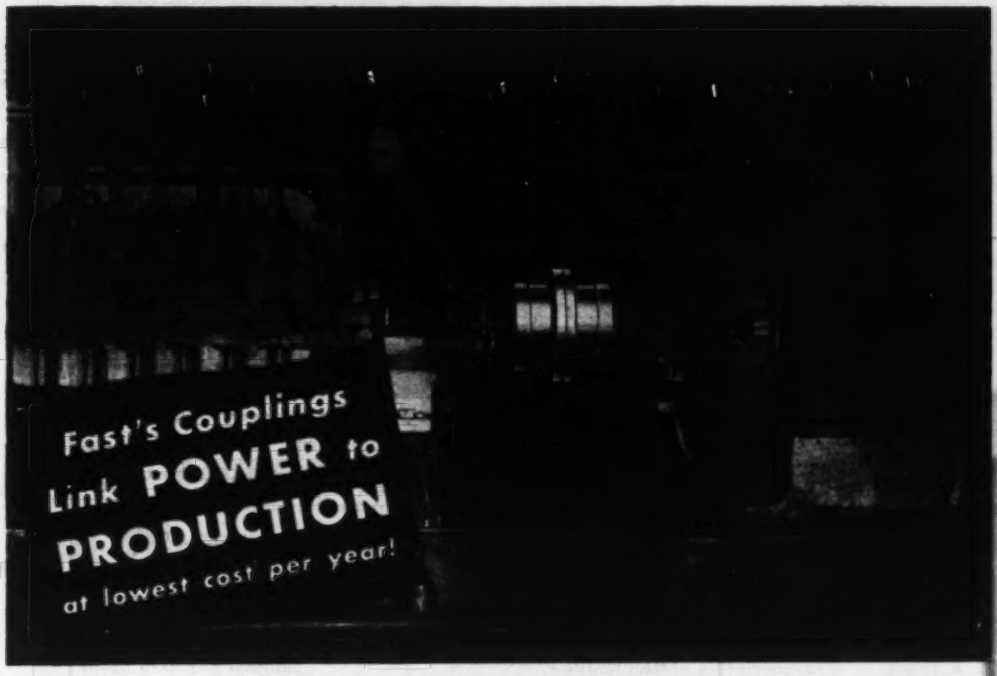

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Solve your coupling worries! Write today for full details on Fast's Couplings and Koppers Engineering Service to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 257 Scott St., Baltimore 3, Maryland.

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Couplings

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Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may affiliate as Associates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

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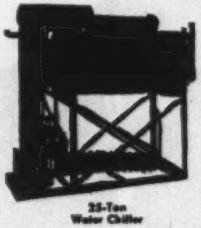

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IT WAS A BRIGHT EARLY DECEMBER DAY and Lieutenant Hudner was flying a Korean combat mission alongside another plane piloted by Ensign Jesse Brown. A burst of flak

caught the ensign's plane and he went spinning down, aflame. Lieutenant Hudner then deliberately crash landed near his flame-trapped shipmate. He radioed for help, after which he fought to keep the fire away from the fatally injured ensign until a rescue helicopter arrived. Today Lieutenant Hudner says:

"Maybe if America had been strong enough to discourage aggression two years ago, my friend, Jesse Brown, might be alive right now. So might thousands more of our Korea dead.

"For it's only too sadly true—today, in our world, weakness invites attack. And *peace is only for the strong.*

"Our present armed forces *are* strong—and growing stronger. But don't turn back the clock! Do your part toward *keeping* America's guard up by buying more . . . and more . . . and more United States Defense Bonds *now!* Back us up. And *together* we'll build the strong peace that all Americans desire!"

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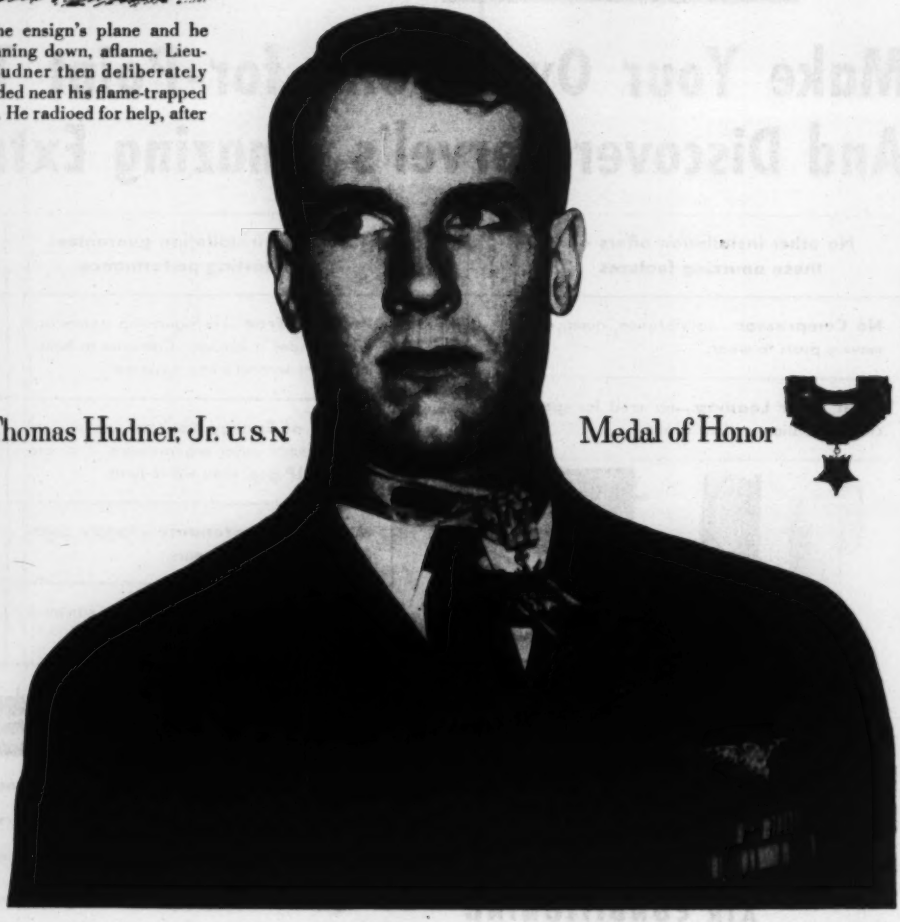
Remember that when you're buying bonds for defense, you're also building a personal reserve of savings. Remember, too, that if you don't save *regularly* you generally don't save at all. So sign up today in the Payroll Savings Plan or the Bond-A-Month Plan. Buy United States Defense Bonds now!

Peace is for the strong...
Buy U.S. Defense Bonds now!



Lt.(jg) Thomas Hudner, Jr. U.S.N.

Medal of Honor

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You get MORE CAPACITY with a FANMIX BURNER

Increase Boiler Ratings On Present Or Planned Equipment

In all types of Coppus-Dennis FANMIX Burners — straight gas or combination gas-oil — we utilize the energy of the fuel under pressure to drive the burner fan and deliver air in the proper proportion to the fuel flow. This exclusive "pinwheel action" *mechanically* mixes fuel and air in exactly the right proportions for truly radiant, non-luminous heat.

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FANMIX Saves On Both Old and New Installations

FANMIX can easily be operated with your present furnace and stack, requiring only minor changes in other equipment. Or if you're planning on new boilers, remember that FANMIX relieves the furnace from the burden of mixing, creates its own forced draft and takes smaller pipe sizes. Which means you can plan on reduced combustion space, less stack, no forced draft equipment and lower installation costs all around.

Get the Whole Story

Coppus engineers FANMIX Burners to meet individual requirements, providing complete control over heat pattern and combustion . . . Learn more about how "pinwheel action" can step up *your* boiler performance to peak efficiency and economy — as it is doing throughout industry. Send for Bulletin 410-6. Coppus Engineering Corp., Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, and MINING CATALOGS.

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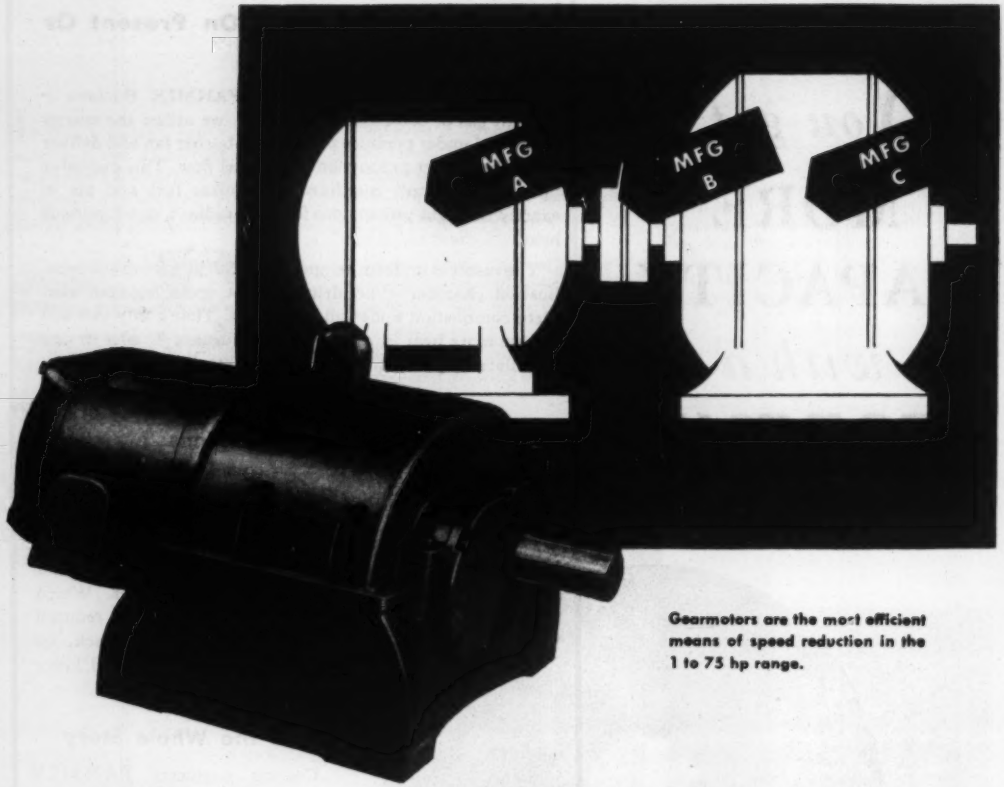


Gearmotors are the most efficient means of speed reduction in the 1 to 75 hp range.

Life-Line GEARMOTORS mean only ONE call for selection...ordering...maintenance

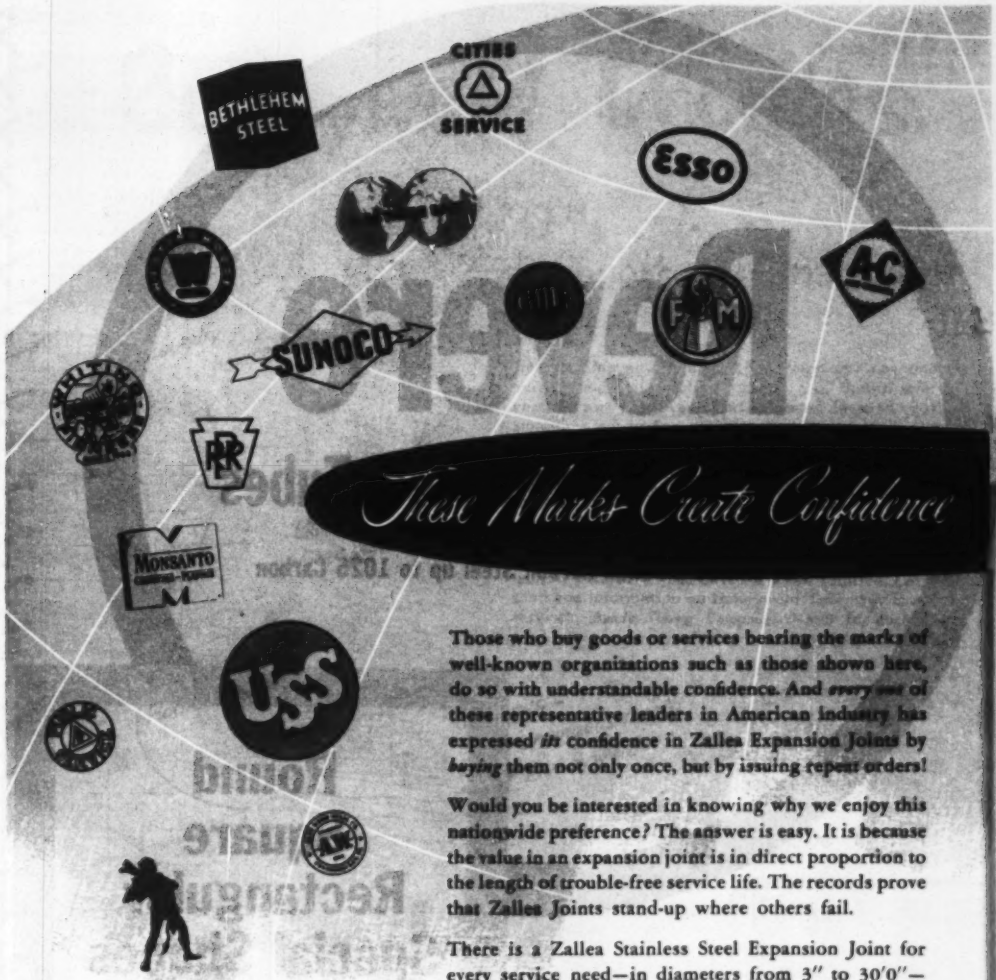
"Get me the local Westinghouse office, please!" In those few words lies the answer to *all* your speed reduction problems. Every component of a Life-Line gearmotor is made and serviced by one manufacturer—Westinghouse. Regardless of what you need you make only one call with Life-Line.

Also, that one call connects you with the most complete nationwide service organization. A ready supply of gearmotor parts—complete facilities to handle every phase of gearmotor repair work—a large staff of field engineers to consult or help you with your drive operating problems.

Eliminate service confusion with Life-Line gearmotors. Ask your Westinghouse representative for full details. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-07312

Life-Line GEARMOTORS



These Marks Create Confidence

Those who buy goods or services bearing the marks of well-known organizations such as those shown here, do so with understandable confidence. And *every one* of these representative leaders in American industry has expressed *its* confidence in Zallea Expansion Joints by *buying* them not only once, but by issuing repeat orders!

Would you be interested in knowing why we enjoy this nationwide preference? The answer is easy. It is because the value in an expansion joint is in direct proportion to the length of trouble-free service life. The records prove that Zallea Joints stand-up where others fail.

There is a Zallea Stainless Steel Expansion Joint for every service need—in diameters from 3″ to 30′0″—pressures ranging from vacuum to 2000 psi—and temperatures from sub-zero to 1600° F. For full details regarding your expansion joint problems or requirements, just get in touch with us. Zallea Brothers, 820 Locust Street, Wilmington 99, Delaware.

Catalog 47 and Bulletin 351 describe the complete line of Zallea Expansion Joints and Flexible Connectors. Write for a copy today.

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Electric Welded Steel Tubes

Hot and Cold Rolled Carbon Steel up to 1025 Carbon

Round
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Rectangular
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Diameters from ¼" O. D. to 4½" O. D.
Wall thicknesses from .025" to .187"

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Technical and Engineering service is available. Consult us on your Steel Tube problems.

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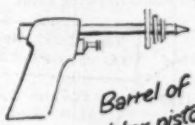
SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

Bundyweld "Doodles"

to jog a designer's imagination

Frame of popular laundry hamper



Barrel of Water pistol

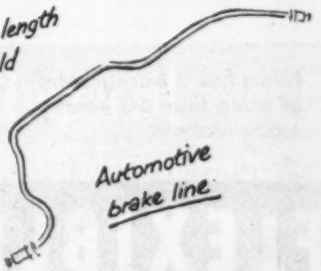
Redesigning an old product? Developing a new one? With Bundyweld Tubing on the job, there's every chance for improved performance, lowered cost, smoother production, or some other practical plus.

No other tubing has all the Bundyweld features. It's the only tubing double-walled from a single strip, with inside and outside beveled edges.

Too, you may profit from Bundy's famous fabrication skills. In working out tubing parts like those shown here, we may have found the answer to something baffling you. Or we can develop a new solution. Let us send you information on Bundyweld Tubing or Bundy services. ***Bundy Tubing Company, Detroit 14, Michigan.***

Coil for a Home Freezer

96 bends – 82' continuous length of Bundyweld



Automotive brake line

Bundyweld® Tubing

DOUBLE-WALLED FROM A SINGLE STRIP

Extra-strong
High fatigue limit
Leakproof
High bursting point
High thermal conductivity
Shock-resistant
Ductile

Easily machined
Takes plating
Takes plastic coating
Scale-free
Clean inside and out
No inside bead
Uniform I.D., O.D.

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Copper coating fuses with steel. Presto . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

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3 Clean, balanced, sturdy and efficient for every type of drawing, sketching, rendering or coloring.

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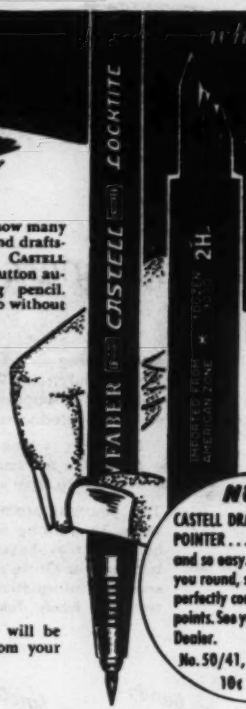

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CASTELL DRAWING LEAD POINTER . . . practical and so easy. Gives you round, sharp, perfectly conical points. See your Dealer. No. 50/41, 10¢

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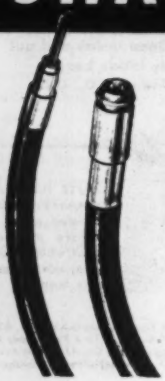

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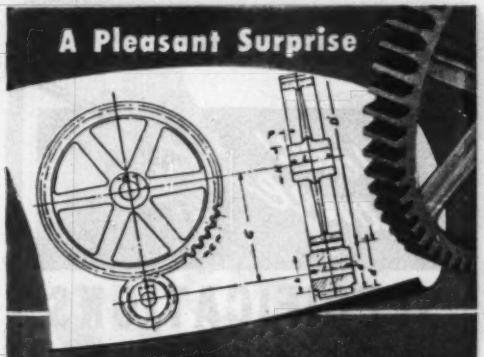
A Pleasant Surprise



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11 x 15" N Fitting.

A wide variety of access openings.

Lenape elliptical access openings (straight rings or flued and curved saddles) and fittings, of the pressure loaded or "self-energized" type are produced in sizes ranging from 4" x 6" to 18" x 24".

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- 12 x 16" Type HP 800 PSI for heavy duty.
- 14 x 18" 300 PSI Hinged for beverage tanks.
- 18 x 24" 200 PSI for large clean-outs.

Full details are found on pages 35-42 of Lenape Catalog 9-49

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DEPT. 106 WEST CHESTER, PA.
RED MAN PRODUCTS

This Saw "Mows 'Em Down

Even With the Ground"

The LITTLE GIANT Saw cuts down trees and stumps at any angle, bulldozes logs, bores post holes, propels itself anywhere a man can walk and loads itself on a truck. ROCKFORD CLUTCHES control power transmission in this versatile unit. Let ROCKFORD clutch engineers help solve *your* power transmission control problems.

ROCKFORD CLUTCH DIVISION

ROCKFORD CLUTCHES

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Erasures are made easily, without damage. It gives sharp, contrasting prints of the finest lines. It resists the effects of time and wear, and does not become brittle or opaque.

Imperial Pencil Tracing Cloth is right for ink drawings as well.

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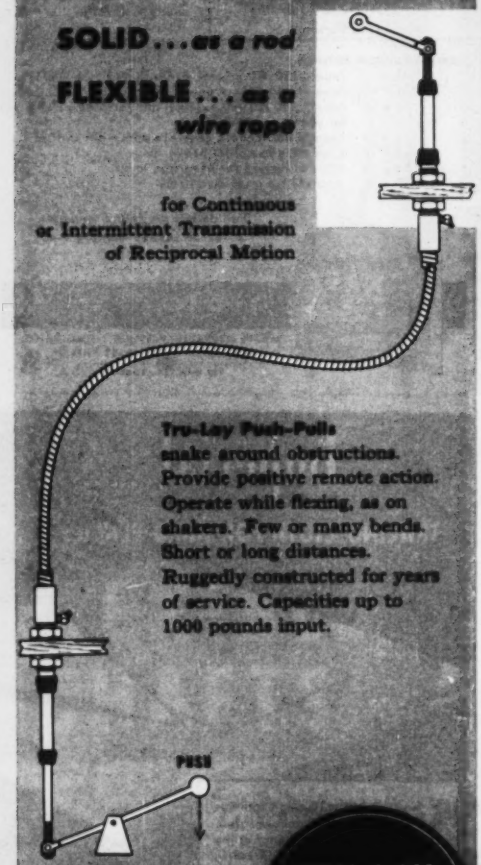
SOLID . . . as a rod

FLEXIBLE . . . as a wire rope

for Continuous or Intermittent Transmission of Reciprocal Motion



Tru-Lay Push-Pulls snake around obstructions. Provide positive remote action. Operate while flexing, as on shakers. Few or many bends. Short or long distances. Ruggedly constructed for years of service. Capacities up to 1000 pounds input.

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AUTOMOTIVE AND AIRCRAFT DIVISION
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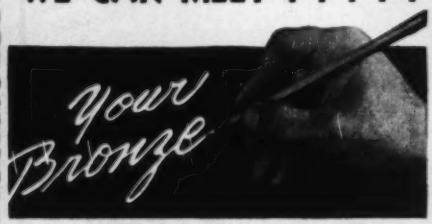

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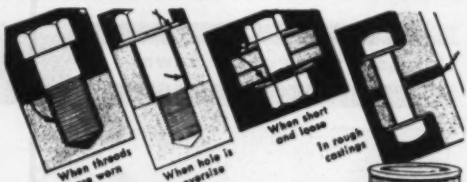
AMERICAN MANGANESE BRONZE COMPANY

4703 RHAWN ST., HOLMESBURG, PHILADELPHIA 36, PA.

Established 1909



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Bolts with worn threads—undersize bolts in oversize holes—bolts passing through thin walls—bolts holding ill-fitting cast flanges—all can be tightened firmly with quick-setting Smooth-On No. 1 Iron Cement. Use it, too, to lock nuts tight, and to cover and protect countersunk bolt heads in metal or wood. These repairs stay tight because Smooth-On expands slightly as it hardens. Buy Smooth-On No. 1 in 7-oz., 1-lb., 5-lb., 20-lb., or 100-lb. size and keep it handy. If your supply house hasn't Smooth-On, write us.

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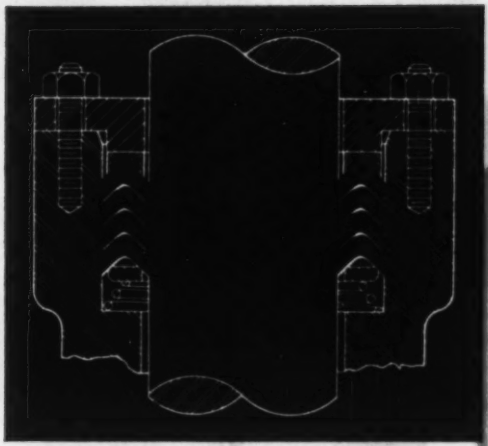

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June, 1952 CARD INDEX Vol. 74, No. 6

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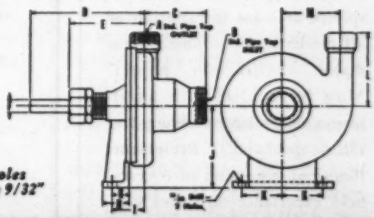

***Foot holes in base 9/32"**

DIMENSION TABLE

No.	A	B	C	D	E	F	G	H	I	J	K	L	M
1G*	⅛	¼	2 7/32	3 5/16	2 5/32	5/16	5/16	⅝	1/64	1 13/16	1⅝	2 3/32	1⅛
4G	⅛	⅝	2 9/16	4 1/16	2 11/16	⅛	⅛	1	1¼	3¼	1⅛	3	2 5/32
9G	1	1¼	2 15/16	5 5/16	3 5/16	⅛	1 1/16	1 5/16	1⅛	3¼	1⅛	3⅝	3 3/32

CAPACITY TABLES

Power No.	Speed	H.P.	Inlet	Outlet	Gallons Per Minute—Head in Feet							
					0	4	6	8	12	16	20	24
1G	1725	1/12	¼	⅛	2.00	1.05	0.10	—	—	—	—	—
1G	3450	1/12	¼	⅛	4.00	3.70	3.50	3.25	2.75	2.10	1.25	0.10
4G	1725	¼	⅝	⅛	10.75	7.50	4.00	—	—	—	—	—
4G	3450	¼	⅝	⅛	23.00	22.00	21.53	21.00	18.75	15.25	11.50	8.00
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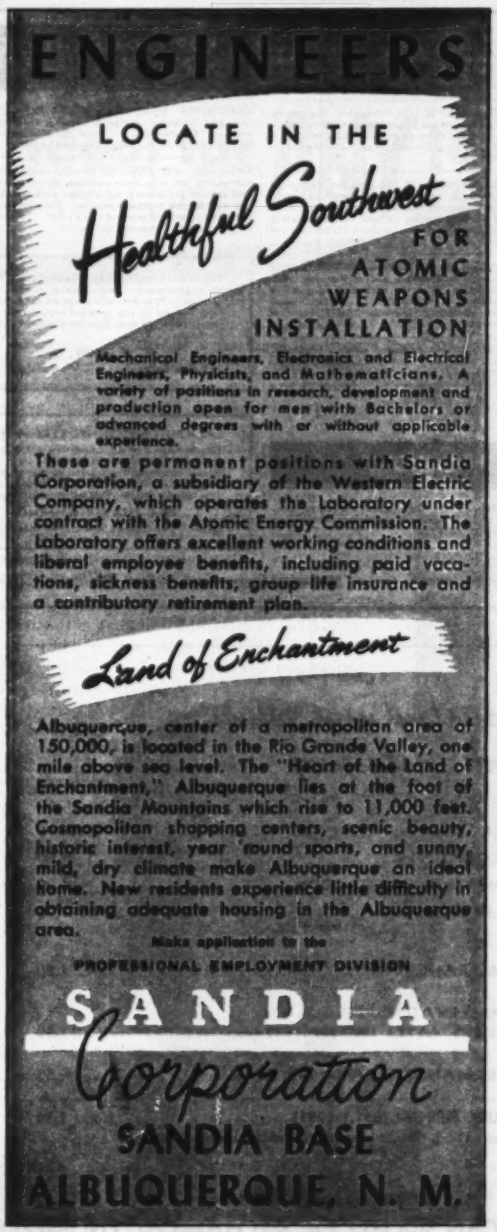
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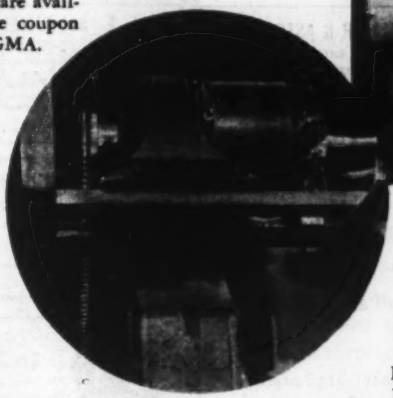

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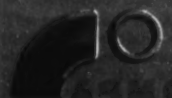


TRUE CIRCULAR SECTION

True circular section at all points makes a Grinnell fitting easy to align and weld . . . there is no distortion or no flattening to affect flow adversely.

FULL EFFECTIVE RADIUS

The loss of pressure through Grinnell welding elbows is held down to an absolute minimum . . . because of the full and the effective sweep of the radius.

SMOOTH, CLEAN INSIDE SURFACE

Grinnell Fittings have uniformly smooth inner walls . . . no waves or ridges to cause turbulence or accelerate erosion or corrosion. No pockets to trap solids.

EASY, SWEEPING TURNS

In Grinnell welding tees, corners where outlet joins the run are well-rounded and perfectly smooth to minimize resistance to flow and to prevent trapping.

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

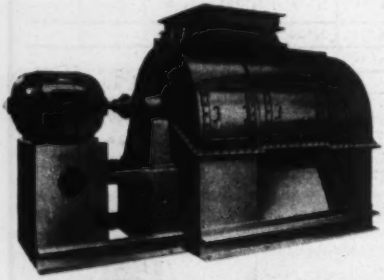
HEADQUARTERS FOR AIR HANDLING AND CONDITIONING EQUIPMENT

. . . . to meet all types of industrial, power plant, commercial and public building requirements.

CLARAGE

The Sign of Resourceful Engineering and Economical Performance

INDUSTRIAL FANS—for blowing or exhausting. Large range of capacity sizes—suitable for many applications.



MECHANICAL DRAFT FANS—both forced and induced draft. Heavy-duty construction for continuous operation at peak loads.

CAST IRON FANS—for industrial services. Unique construction assures extra long life when handling corrosive gases.

What you're looking for in air handling and air conditioning you are likely to find at Clarage Fan . . . highly efficient, dependable equipment — job engineered to your particular needs . . .

It's nearly 40 years since we started building fans, blowers and allied products. We have had ample time to temper research with experience, engineering with sound practice, manufacturing to actual operating in-the-field demands . . . .

You can profit by dealing with Clarage. We have an established reputation for getting things done right . . . . As evidence of what we mean, 97 of the 100 largest American corporations are users of Clarage fan equipment. Need we say more?

CLARAGE FAN COMPANY

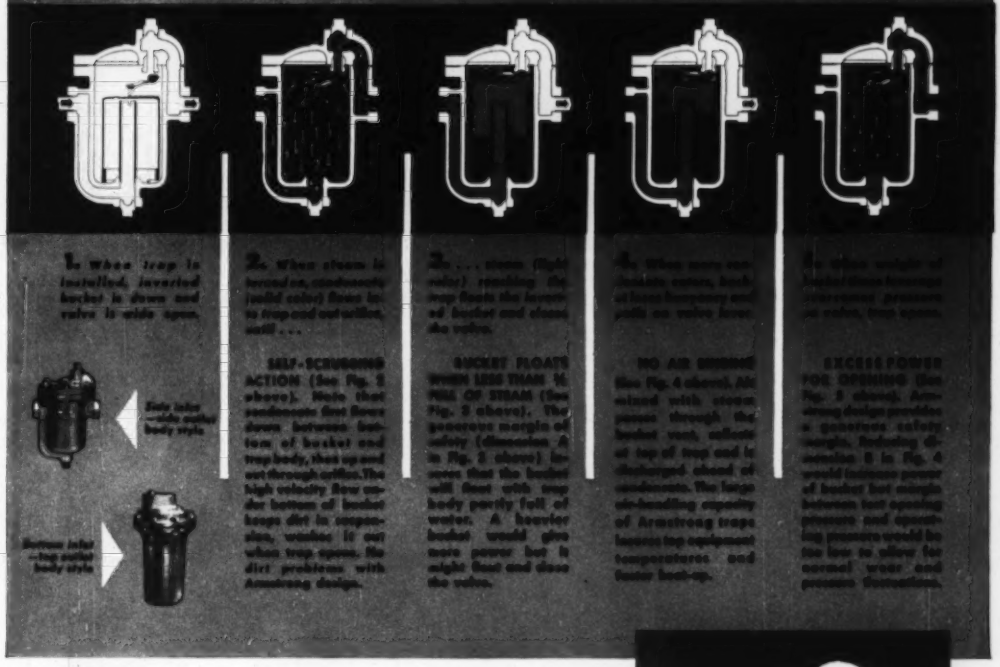
609 PORTER ST., KALAMAZOO, MICH.

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

IN CANADA: 4285 Richelieu St., Montreal
Canada Fans, Ltd.

You Can Rely on Clarage

ARMSTRONG TRAPS are Designed to give Outstanding Performance



THE highly efficient design of modern Armstrong traps reflects over 40 years' experience in inverted bucket trap manufacture and application.

ARMSTRONG design offers:

- A "frictionless" leverage system which combines high leverage with wide opening of a large orifice.
- A minimum of parts.
- Strong, corrosion-resistant and wear-resistant materials.
- Generous margins of safety.

FOR TRAP USERS this means:

- Large capacity.
- Dependable service under adverse operating conditions.
- Low maintenance.
- Continuous operation of heating and process equipment.

The soundness of Armstrong design has been proved in thousands of plants all over the world. To insure dependable condensate drainage simply specify: "Traps shall be Armstrong." For additional information, call your local Armstrong Representative or write:

ARMSTRONG MACHINE WORKS
894 Maple Street, Three Rivers, Michigan

● ***SEND FOR*** **NEW 44-PAGE STEAM TRAP BOOK.** Complete data on Armstrong trap design and operation; physical data and list prices; capacities; selection, installation and maintenance recommendations Free on request.

ARMSTRONG STEAM TRAPS

New lathe for facing jet engine disks gets precision with TIMKEN® bearings

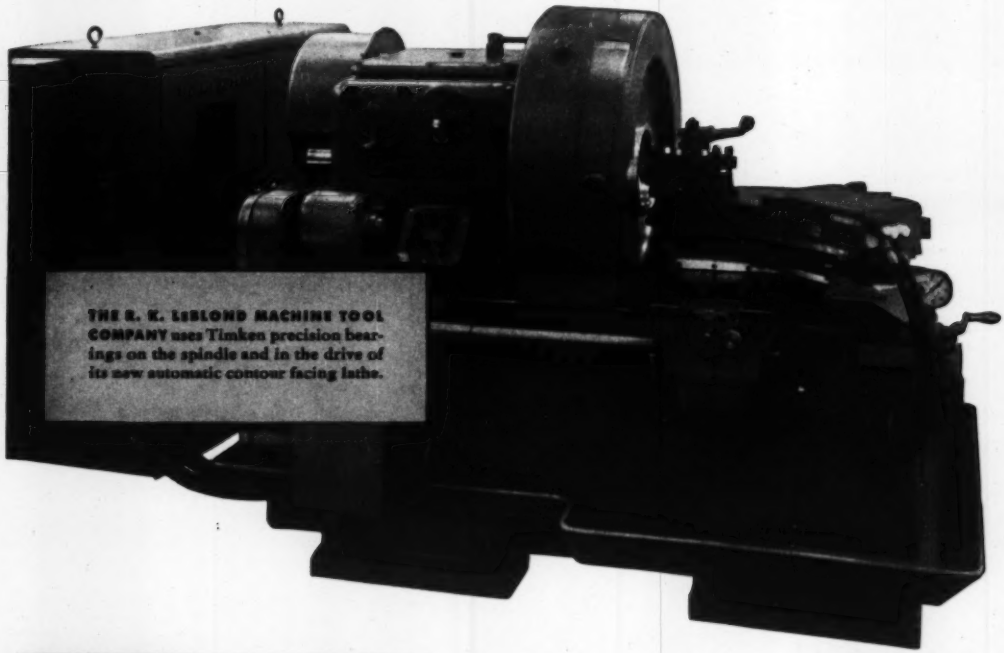
THIS new LeBlond automatic contour facing lathe is especially designed for machining compressor and turbine disks for jet engines. Outside shoulders of the disk contours are machined when feeding from front to center and inside shoulders are machined when feeding from center to rear. To accomplish this, the spindle automatically reverses when the tool reaches the center. And the lathe gets high precision with Timken® precision bearings on the spindle and in the drive.

Timken precision bearings are made especially for spindle applications; their run-out tolerances can be held as close as 75 millionths of an inch. The tapered design of Timken bearings enables them to take radial and thrust loads or any combination, holds spindles in rigid alignment. It also permits pre-loading to any desired degree to prevent chatter. Line contact between the rollers and races of Timken bearings gives them adequate capacity for any tool loads.

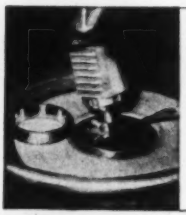
LeBlond has found that Timken precision bearings are easy and less costly to assemble because they're tapered in design, eliminate the need for auxiliary thrust bearings. Spindle maintenance is simplified.

Timken precision bearings have been an important factor in the development of precision machine tools for the past 25 years. Make sure you have them in all the machinery you build or buy. Always look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



THE R. K. LEBLOND MACHINE TOOL COMPANY uses Timken precision bearings on the spindle and in the drive of its new automatic contour facing lathe.



FINISHED TO CLOSER TOLERANCES

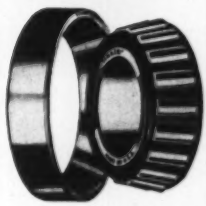
Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION ✳